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ERRATA

Page 9 line 20, for " phosphorodithioate)" read " phosphorodithioate))"

,, 11 13 lines from end, for " methylphosphoramidoithioate " read " methylphosphoramidothioate "

,, 26 16 lines from end, for " *nuttali* " read " *nuttalli* "

,, 31 15 lines from end, for " alkyl " read " allyl "

,, 37 line 4, for " *Musca stabulans* " read " *Muscina stabulans* "

,, 52 line 5, for " *G. palpalis* " read " *G. palpalis* (R.-D.)"

,, 110 line 3, for " Macleod " read " MacLeod "

,, 149 first line, for " Buéi (V. K.)" read " Buéi (K.)"

,, 154 8 lines from end, for " chlorophenyl " read " dichlorophenyl "

,, 175 15 lines from end, for " *spegazinii* " read "*spegazzinii* "

,, 212 11 lines from end, for " *Cyclorrhapha* " read " Cyclorrhapha "

,, 263 11 lines from end, for " *funicula* " read " *funicola* "

,, 276 line 2, for " 244 " read " 246 "

COMMONWEALTH INSTITUTE OF ENTOMOLOGY.

REVIEW
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SERIES B.

Vol 49. 1961.

EDITORIAL

THE NOMENCLATURE OF CHEMICALS USED IN PEST CONTROL

It has been considered desirable to make some additions and alterations to the recent list of common names accepted in this *Review* for chemicals employed in pest control [*R.A.E.*, B **48** 1–7]. Since its publication, further common names have been approved by the British Standards Institution, and a complete revision of British Standard 1831: 1957 and its Supplements, incorporating them, is shortly to be issued. The additional names from this source that will be used in abstracts, normally without further chemical definition, are shown in the table below. It will be noted that the name azinphos-methyl is accepted for Guthion and mevinphos for Phosdrin, both of which were included in the earlier list [*loc. cit.*].

Common name used	Chemical names or definitions	Other names
azinphos-ethyl ..	O,O-diethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate O,O-diethyl S-(3,4-dihydro-4-oxobenzo[*d*]-[1,2,3]-triazin-3-ylmethyl) phosphorodithioate	Bayer 16259
azinphos-methyl ..	O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate O,O-dimethyl S-(3,4-dihydro-4-oxobenzo[*d*]-[1,2,3]-triazin-3-ylmethyl) phosphorodithioate	Guthion, Gusathion, Bayer 17147
chromaphon ..	O,O-diethyl O-(7,8,9,10-tetrahydro-6-oxo-benzo[*c*]chroman-3-yl) phosphorothioate	
coumaphos ..	O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphorothioate	Bayer 21/199, Co-Ral
fenchlorphos ..	O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate	ronnel, Dow ET-14, Dow ET-57, Korlan, Trolene

Common name used	Chemical names or definitions	Other names
fenthion	O,O-dimethyl O-3-methyl-4-methylthiophenyl phosphorothioate	
mecarbam.. ..	O,O-diethyl S-(N-ethoxycarbonyl-N-methylcarbamoylmethyl) phosphorodithioate	
menazon	O,O-dimethyl S-(4,6-diamino-1,3,5-triazin-2-yl)methyl phosphorodithioate	
metham	N-methyldithiocarbamic acid It should be stated which salt or ester is present.	
mevinphos ..	dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate	Phosdrin
morphothion ..	O,O-dimethyl S-morpholinocarbonylmethyl phosphorodithioate	
prodizine	2-chloro-4-diethylamino-6-isopropylamino-1,3,5-triazine	

Gunther (F. A.) & Jeppson (L. R.). **Modern insecticides and world food production.**—9 × 6 in., xv + 284 pp., 31 pls., many refs. London, Chapman & Hall, Ltd., 1960. Price £2 10*s*.

This book, which is reviewed more fully elsewhere [*R.A.E.*, A **49** 44], is concerned mainly with insects that infest crops, but contains some information on insects, mites and ticks that attack domestic animals and the control or prevention of attack by means of toxic or repellent chemicals.

Levenbook (L.). Ed. **Biochemistry of insects.**—*Proc. 4th int. Congr. Biochem. Vienna 1958* **12**, 9¼ × 6 in., xviii + 252 pp., illus., many refs. London, &c., Pergamon Press Ltd., 1959.

One of the symposia of the Fourth International Congress of Biochemistry held at Vienna in September 1958 concerned the biochemistry of insects, and the papers read are here presented, together with the discussions, the opening address and a report of the work. The papers include **Biochemical aspects of insect poisons,** by M. Pavan (pp. 15–35, 2 pls., 7 figs., 66 refs.), which is a review of knowledge on the chemistry of the venoms produced by insects and other arthropods; **Comparative aspects of insect biochemistry with particular reference to insecticidal action,** by F. P. W. Winteringham (pp. 201–210, 44 refs.); and **The metabolism of insecticides by insects,** by J. E. Casida (pp. 216–236, 3 pp. refs.), in which the main insecticides considered are DDT, BHC, pyrethrum and phosphorus compounds, metabolic routes are discussed, and the problem of acquired resistance is treated briefly.

Mattson (A. M.), Fay (R. W.), Gaines (T. B.) & Pearce (G. W.). **Preparation and biological activity of a series of halogenated ethyl and vinyl dimethyl phosphate esters.**—*J. agric. Fd Chem.* **8** no. 3 pp. 196–198, 7 refs. Easton, Pa., 1960.

Details are given of experiments on the toxicity to house-flies (*Musca domestica* L.) and rats of a series of tertiary phosphate esters with two methyl groups as constant constituents, the synthesis of which is described. The flies were treated by topical application of acetone solutions, and solutions in groundnut oil were administered orally to the rats. The LD50's for the flies and (in brackets) the rats in mg. per kg. body weight were 2·7 (250) for dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate, 3·8 (184) for dimethyl 1,2,2,2-tetrabromoethyl phosphate, 6·8 (253) for dimethyl 2,2-dibromovinyl phosphate, 4·2 (80) for dimethyl 2,2-dichlorovinyl phosphate (dichlorvos), 3·3 (49) for dimethyl 2,2-dibromo-1,2-dichloroethyl phosphate and 8·2 (14) for dimethyl 1,2,2,2-tetrachloroethyl phosphate. The first of these compounds was toxic to rats when applied dermally and to fowls when injected subcutaneously.

Hall (I. M.) & Arakawa (K. Y.). **The susceptibility of the house fly, *Musca domestica* Linnaeus, to *Bacillus thuringiensis* var. *thuringiensis* Berliner.**—*J. Insect Path.* **1** no. 4 pp. 351–355, 1 ref. New York, N.Y., 1959.

The following is based on the authors' summary. In laboratory experiments, adults of *Musca domestica* L. showed only slight susceptibility to *Bacillus thuringiensis* var. *thuringiensis* in feeding tests, but larvae of several strains were easily killed by doses of 0·125–0·5 g. concentrated spore material (150,000 million spores per g.) per 40 g. medium. Few of the deaths were due to septicaemia, and most of the larvae seemed to have been killed by the toxic effect of the crystalline inclusion bodies present in the infective material.

O'Brien (R. D.). **Effect of ionization upon penetration of organophosphates to the nerve cord of the cockroach.**—*J. econ. Ent.* **52** no. 5 pp. 812–816, 6 figs., 15 refs. Menasha, Wis., 1959.

There is evidence that several potentially toxic compounds are without effect upon insects because they fail to penetrate the nerve cord. The penetration *in vitro* of the nerve cord of adults of *Periplaneta americana* L. by ionised, non-ionised and ionisable organophosphates was studied, and the following is virtually the author's abstract of the results. TEPP, which is not ionised, penetrates about as rapidly into the intact as into the excised nerve cord. Amiton iodide, which is ionised, penetrates the excised cord well, but the intact cord extremely poorly; these effects are independent of pH. Amiton oxalate, an ionisable compound, penetrates the excised nerve cord well and independently of pH, but penetrates the intact cord poorly at low pH (at which it is ionised) and well at high pH (at which it is not ionised). These results confirm the presence of an ion-barrier in the intact nerve cord, and demonstrate the importance of avoiding basicity in insecticidal organo-phosphates.

Neal (T. J.) & Lipovsky (L. J.). **Techniques for rearing the chigger mite, *Trombicula akamushi* (Brumpt).**—*J. econ. Ent.* **52** no. 5 pp. 824–826, 2 figs., 5 refs. Menasha, Wis., 1959.

Methods of rearing *Trombicula akamushi* (Brumpt) have been described that used rats and mice as larval hosts and *Culex* and dragonfly eggs as food for the postlarval stages, but the techniques of attaching the larvae to the host were not successful. In August 1956, a colony of *T. akamushi* was established in which larvae, collected from a wild rat in Malaya, were fed on chicks and white rats, and the post-larval stages on the eggs of the Entomobryid, *Sinella curviseta* Brook.

The following is taken largely from the authors' abstract. A silk sack for the attachment of the larval mites to the wings of the chicks is described, and a capsule for their attachment to the rats is described and illustrated. Apparatus for holding the chicks while the larvae are feeding is illustrated and briefly described. A description is also given of methods for rearing *S. curviseta*, dry activated yeast being used as food.

Cheng (Tien-hsi), Frear (D. E. H.) & Enos jr. (H. F.). **Effectiveness of aerosol formulations containing methoxychlor and other insecticide-repellents against biting flies on cattle, and analyses of milk from treated animals.**—*J. econ. Ent.* **52** no. 5 pp. 866–868, 1 fig., 4 refs. Menasha, Wis., 1959.

Methoxy-DDT (methoxychlor) alone or with other insecticides in sprays has given good control of the biting-flies, *Siphona irritans* (L.) and *Stomoxys calcitrans* (L.), on cattle in Pennsylvania, but residues of it were found in milk of treated animals [*R.A.E.*, B **48** 20]. Further tests were carried out in June–September 1958 to determine whether aerosol formulations of methoxy-DDT were effective against these flies and whether they could be used on lactating cows without contaminating their milk. Aerosols were applied to the cattle from three containers attached to a rectangular wooden frame and activated by an automatic photoelectric device [*loc. cit.*] on the frame. The aerosol was released as cattle passed through the frame, once daily. Each animal was sprayed for an average of 1·5 seconds and received about 7 ml. spray. Five formulations (lettered A–E) were used on five groups of 28 lactating cows, and five groups of untreated ones were kept apart as controls. A & B consisted of 1 per cent. methoxy-DDT and 60 per cent. propellent with, respectively, 15 per cent. N,N-diethyl-m-toluamide and 3 per cent. Thanite, the remainder being deodorised kerosene (Deobase); C contained 2 per cent. methoxy-DDT, 60 per cent. propellent, 2 per cent. MGK R-326 (di-*n*-propyl isocinchomeronate), 2 per cent. MGK 264 [N-(2-ethylhexyl)bicyclo(2.2.1.)-5-heptene-2,3-dicarboximide], and 34 per cent. petroleum distillate; D and E consisted of 0·2 per cent. pyrethrins, 2 per cent. piperonyl butoxide and 50 per cent. propellent with, respectively, 2 and 4 per cent. methoxy-DDT, the remainder being petroleum distillate. Fly counts were made twice daily, six and 11 hours after treatment, on the treated and untreated animals. Milk samples were extracted by the method of Carter [**38** 180] and the methoxy-DDT was determined by the method of Claborn & Beckman [**41** 48], which is sensitive to 0·01 part per million. The percentage reductions in populations of *Siphona* and (in brackets) *Stomoxys* achieved by the formulations A, B, C, D and E, were 96·7 (48·3), 93·4 (30·7), 95·3 (41·9), 98·6 (48·1) and 98·9 (61·5), respectively. The limited control of *Stomoxys* may have been due to the low concentration of some of the principal ingredients, or it may be attributable to the selective power of this fly, for an average of 48·4 per cent. of those counted on treated cows were found on parts of the head to which the spray had not been applied or from which it had been washed away during drinking or grazing in wet grass. Analyses of milk samples showed no detectable amount of methoxy-DDT.

Davis (A. N.), Gahan (J. B.), Weidhaas (D. E.) & Smith (C. N.). **Exploratory studies on gamma radiation for the sterilization and control of** *Anopheles quadrimaculatus*.—*J. econ. Ent.* **52** no. 5 pp. 868–870, 3 refs. Menasha, Wis., 1959.

Preliminary laboratory studies were conducted to determine the effect of γ-radiation on *Anopheles quadrimaculatus* Say. Two activated cobalt (^{60}Co) radiation sources that gave an average of about 400 r and 1,000 r per minute, respectively, were used. Duplicate tests were made on the effect on the fertility of adults of exposing groups of 50 day-old pupae to 3,200, 6,400 and 12,900 r in the smaller radiation source. Adults that emerged were offered a human blood-meal, honey and boiled water each day until they died. Daily records showed that irradiation of pupae did not reduce or delay adult emergence, but that more adults from the irradiated pupae died during the first three days than from the pupae not so exposed, though some fertile eggs were laid by females from all the groups of irradiated pupae. Pupae of various ages between one and 24 hours were exposed, in groups of 50, to 8,865 r in the smaller source. Three days after emergence, adult mortality was highest in groups from pupae treated when one or four hours old. Eggs were obtained from groups treated when 8–24 hours old, but not more than 2 per cent. hatched. Adults themselves exposed to 1,500 or 2,500 r in the smaller source laid a normal number of eggs within 24 hours after emergence, all of which hatched. At 5,000 r, the number and fertility of the eggs was slightly reduced, and at 8,865 r only a few eggs were laid, none of which hatched. Almost twice as many eggs were deposited by females that had received 1,500 or 2,500 r as by untreated females.

Pupae, one day old, were exposed to 11,820 r in the larger source, and the males that emerged were separated from the females when they were less than 20 hours old. Populations composed of various combinations of males and females from irradiated pupae and of normal males and females were established. Females from treated pupae mated to normal males produced no eggs, but normal females mated to males from treated pupae produced a normal number of eggs, though none hatched. When males from irradiated pupae were introduced into populations of normal males and females at ratios of 4:1:1 or less, egg production was at or above normal levels, so that although egg fertility was slightly reduced, there was usually no reduction in the total number of viable eggs. At ratios of 6:1:1 and 10:1:1, both the number and fertility of the eggs was so reduced that there was about 80 per cent. reduction in the number of viable eggs. To obtain information on multiple matings, normal males and females were confined together for various periods and oviposition records were maintained for three weeks. More than one mating by the males was indicated, but since females kept with an equal number of males for only three days produced slightly more eggs than did those kept with males for 21 days, frequent matings by females do not appear to be necessary. Exposure of eggs, fourth-instar larvae and pupae to 5–8 dosages of irradiation in the larger source showed that the dosages required to cause 50 and (in brackets) 100 per cent. mortality in 48 hours were 2,600 (711,000), 32,000 (120,000) and 22,000 (40,000) r, respectively.

Lewis (L. F.). **On the biology of** *Chrysops flavida* **in the Yazoo-Mississippi Delta.**—*J. econ. Ent.* **52** no. 5 pp. 884–888, 12 refs. Menasha, Wis., 1959.

The following is virtually the author's abstract. Several hundred larvae of *Chrysops flavida* Wied. were collected in the Delta area of Mississippi in

1955–56. Some were collected from around the roots of an emergent sedge, and others from around sedge in habitats that were dry for more than six months. Adults emerged in the laboratory in every month except August, September and November. The average pupal period was five days. In the laboratory, submerged larvae fed readily on bloodworms [Chironomid larvae], but took no other food. Larvae in the laboratory remained alive after being confined below water for 21 days.

Furman (D. P.), Young (R. D.) & Catts (E. P.). *Hermetia illucens* **(Linnaeus) as a factor in the natural control of** *Musca domestica* **Linnaeus.**—*J. econ. Ent.* **52** no. 5 pp. 917–921, 2 refs. Menasha, Wis., 1959.

The following is based almost entirely on the authors' abstract. *Hermetia illucens* (L.) was reared in the laboratory from larvae collected from poultry manure in the field. Newly-hatched larvae of this Stratiomyiid took two weeks or longer to attain full growth at 30°C. [86°F.] in moist standard house-fly breeding medium. No evidence of paedogenesis was demonstrated. Larvae displayed little resistance to temperatures about freezing point. The pupal stage lasted about two weeks at temperatures of 21–28°C. [69·8–82·4°F.] but was as long as 5 months in a few examples. Adults kept at about 30°C. were active and fed on solutions of honey or sugar. Adults refused to mate in cages 25 cu. ft. in volume, but some sterile egg-masses were deposited. In laboratory cultures of *H. illucens* and *Musca domestica* L., the percentage of successful development of the latter decreased as the number of actively feeding larvae of the former increased, but this relationship was modified by the total amount of larval medium available. Larvae of *H. illucens* were not cannibalistic or predacious on larvae of *M. domestica*, although they ate dead house-flies. During field observations from October 1957 to September 1958 in the upper San Joaquin Valley, California, adults of *H. illucens* were observed to be active from April to November with a peak in late August. Larvae occurred in poultry manure throughout the year, but were relatively inactive during the winter. *M. domestica* was rarely found breeding in manure where larvae of *H. illucens* were abundant and it is suggested that the more rapidly developing house-fly larvae are starved out by them. Artificial infestation of poultry droppings with larvae of *H. illucens* prevented house-fly breeding, while adjacent moist control sections became heavily infested with *M. domestica*.

Schmidt (C. H.), Acree jr. (F.) & Bowman (M. C.). **Fate of C^{14}-diethyltoluamide applied to guinea pigs.**—*J. econ. Ent.* **52** no. 5 pp. 928–930, 4 refs. Menasha, Wis., 1959.

A technique is described for the study of the evaporation and absorption from the skin of guineapigs of N,N-diethyl-m-toluamide, an insect repellent with high activity [*R.A.E.*, B **46** 99], labelled with radioactive carbon (^{14}C). When doses of 6·97 and 7·11 mg. radioactive diethyltoluamide per sq. in. were applied to two guineapigs weighing 985 and 740 g., 0·96 and 0·98 mg. per sq. in. were lost by evaporation and 1·32 and 3·46 mg. per sq. in. by absorption in six hours. Very small amounts of radioactivity were found in the blood, skin, hair and faeces. Radioactivity in the skin was halved after 72 hours, and after 9 days was less than 10 per cent. of the count taken after six hours. Radioactivity in the urine reached a peak within 12 hours after application, and over 80 per cent. of the absorbed dose was excreted in 24 hours, but ultraviolet absorption spectra did not reveal unchanged diethyltoluamide in the urine. The percentages of the applied dose accounted for were 99 and 98·1.

Lovell (J. B.) & Kearns (C. W.). **Inheritance of DDT-dehydrochlorinase in the house fly.**—*J. econ. Ent.* **52** no. 5 pp. 931–935, 4 figs., 5 refs. Menasha, Wis., 1959.

The following is substantially the authors' abstract. A modification of a method by Sternburg *et al.* (1954) was used to assay the DDT-dehydrochlorinase in individuals of a population of DDT-resistant *Musca domestica* L. A measure of the variability of this enzyme in a population was obtained, and it was possible to relate the concentration of DDT-dehydrochlorinase in parents with that in offspring. The enzyme activity of the progeny appeared to drift toward a mean value, regardless of that of the individual parents. After selection for resistance to DDT alone flies had considerably less DDT-dehydrochlorinase than after being selected for resistance to a combination of DDT and DMC. A strain selected for resistance to the combination was crossed with a susceptible one, and the progeny inbred and back-crossed with susceptible flies to determine the pattern of inheritance of DDT-dehydrochlorinase and its relation to resistance. By this means, a quantitative relation between the presence of DDT-dehydrochlorinase and resistance to DDT was established. The pattern of inheritance of resistance and DDT-dehydrochlorinase activity showed no serious discrepancy with the proposal of Milani that resistance to DDT may be governed by a single partly dominant gene [*cf. R.A.E.*, B **45** 63, etc.; **48** 211], behaving according to simple Mendelian principles.

Piquett (P. G.) & Gersdorff (W. A.). **Screening tests in 1957 with synthetic compounds for toxicity to house flies when applied in space sprays.**—*J. econ. Ent.* **52** no. 5 pp. 954–955, 1 ref. Menasha, Wis., 1959.

The results are given of further preliminary evaluations by the Campbell turntable method [*R.A.E.*, B **26** 246] of the effectiveness of 107 synthetic compounds when applied as space sprays for control of *Musca domestica* L. [*cf.* **48** 54]. The compounds were tested as solutions in refined kerosene (Deobase) at a concentration of 20 mg. per ml., and acetone was sometimes added as an auxiliary solvent. Sprays containing 1, 2 and 4 mg. pyrethrins per ml. Deobase were used as standards of comparison. Eleven compounds, all but one esters of *dl-cis-trans*-chrysanthemic acid, phosphoric acid, or a substituted phosphonic acid, were sufficiently toxic to warrant further study; their toxicity was 2–40 per cent. of that of the pyrethrins, or possibly higher.

Rogoff (W. M.) & Kohler (P. H.). **Free-choice administration of ronnel in a mineral mixture for the control of cattle grubs.**—*J. econ. Ent.* **52** no. 5 pp. 958–962, 16 refs. Menasha, Wis., 1959.

Fenchlorphos (ronnel) in feed additives has provided some control of *Hypoderma* larvae in cattle [*cf. R.A.E.*, B **48** 56]. In South Dakota, calves infested with *H. lineatum* (Vill.) and *H. bovis* (Deg.) were given free access to technical fenchlorphos incorporated in a 3:1 salt-bonemeal mixture, in 1956, 1957 and 1958. Three formulations of this were used, containing 16, 40 and 48 g. fenchlorphos per lb. The calves, in uniform groups according to weight and sex, were kept for periods ranging from 28 to 66 days, beginning in November and December each year, in sheds provided with boxes that contained the mixture, and these afforded the only source of mineral supplement during the tests. Fenchlorphos was omitted from the mixture for control cattle, and the effect of the insecticide on palatability was evaluated by comparing the amounts taken by the various groups of animals. The latter were weighed monthly, and infestation was determined by extraction of the *Hypoderma* larvae at three-monthly intervals beginning in February each year, or by palpation. Blood-cholinesterase activity was determined.

The average amount of mineral mixture consumed varied from 0·31 to 1·88 oz. per day, and the amount of fenchlorphos in it did not seem to affect total consumption. Control was complete at concentrations of 40 and 48 g. fenchlorphos per lb. administered for 59 and 66 days, respectively, and was usually so with 40 g. for 28 days, but was generally inadequate (48–77 per cent. reduction) or fair (82 per cent. reduction) with 16 g. The relative numbers of larvae of *H. lineatum* and *H. bovis* present indicated no difference in their susceptibility to the treatment. At dosages that were the most successful for the elimination of larvae, erythrocyte-cholinesterase levels were significantly depressed and weight gains reduced. Unequal dosage due to variable mineral consumption by animals is a major disadvantage of this method of treatment.

SCHMIDT (C. H.) & WEIDHAAS (D. E.). **Effect of varying conditions in a laboratory testing technique on the mortality of mosquito larvae.**—*J. econ. Ent.* **52** no. 5 pp. 977–979, 7 refs. Menasha, Wis., 1959.

The effect of various factors on the mortality of mosquito larvae exposed to insecticides has been studied [*cf. R.A.E.*, B **47** 18; **48** 220, etc.], but no experiments have been reported with a variety of insecticides against a range of species. Tests were carried out on the effects of varying the volume of insecticide solutions or acetone-suspensions and the size of the container on the mortality of fourth-instar larvae of *Anopheles quadrimaculatus* Say, *Aëdes taeniorhynchus* (Wied.) and *A. aegypti* (L.). In each test, batches of 25 larvae were exposed to solutions or suspensions of dieldrin, γ BHC (lindane), parathion, malathion and ^{14}C-labelled DDT, and mortality counts were made after 24 hours. In some tests, the amount of DDT present in the larvae at the end of the exposure was determined. In the first series of tests, the concentration of toxicant was kept constant and the volume of suspension was varied from 100 to 1,000 ml. With parathion there was no significant change in mortality for any of the species when the volume was increased tenfold. With the other toxicants, mortality increased with the volume of suspension or solution, the increase being greater and more consistent with the DDT suspension than with the other materials. Increase in mortality was greater with larvae of *Anopheles* and *Aëdes taeniorhynchus* than with *A. aegypti*. In the second series of tests, glass containers of four diameters varying from 3 to 6 in. were used, but the concentration of toxicant, the number of larvae, and the volume of suspension were kept constant. No changes in mortality were noted with parathion and malathion. With γ BHC and dieldrin, no appreciable change was seen with *A. aegypti* and *A. taeniorhynchus*, but the mortality of *Anopheles* showed a progressive decrease as container diameter increased. With DDT, the mortality of *Anopheles* decreased regularly from 92 per cent. for the smallest diameter to 32 per cent. for the largest; no change was observed with *Aëdes taeniorhynchus*, and *A. aegypti* showed a decrease in mortality in the 6-inch jar only. With the increase in the diameter of the containers, the dose of DDT absorbed decreased slightly in *Anopheles* and *Aëdes aegypti* and considerably in *A. taeniorhynchus*.

MOORE (B.), DRUMMOND (R. O.) & BRUNDRETT (H. M.). **Tests of insecticides for the control of goat lice in 1957 and 1958.**—*J. econ. Ent.* **52** no. 5 pp. 980–981, 4 refs. Menasha, Wis., 1959.

In view of reports from ranches in south-western Texas of unsatisfactory control of the biting lice, *Damalinia* (*Bovicola*) *caprae* (Gurlt) and *D.* (*B.*) *limbata* (Gerv.), on goats with toxaphene, experiments were carried out in 1957 and 1958 to determine the relative effectiveness of chlorinated-hydrocarbon insecticides and of newer compounds against lice from such ranches.

In preliminary laboratory tests, heavily infested goats from two ranches were dipped into insecticides at recommended dosages. In the tests with goats from the first ranch all insecticides were effective. DDT at a concentration of 0·25 per cent. gave 100 per cent. mortality in 48 hours, but the other insecticides, including toxaphene at the same concentration, required 1–2 weeks. DDT at 0·25 per cent. and methoxy-DDT (methoxychlor) at 0·5 per cent. eradicated lice on goats from the second ranch, γ BHC gave good immediate control but reinfestation developed within three weeks, and 0·25 per cent. toxaphene, which had previously been very effective, gave little control, which indicates that the lice were resistant to it.

In extensive field tests, sprays of Delnav (2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate), trichlorphon (Dipterex), coumaphos (Bayer 21/199), Sevin, fenchlorphos (ronnel), malathion and toxaphene were applied to 23 flocks infested with biting lice, one of which was also infested with sucking lice, *Linognathus stenopsis* (Burm.). Each animal was treated with about one U.S. quart spray, and the degree of wetting obtained varied with the length and density of the hair. Goats were examined before treatment, 24 hours afterwards and then at various intervals. Coumaphos and malathion at 0·1, Delnav and trichlorphon at 0·15, and Sevin and fenchlorphos at 0·25 per cent. concentrations gave complete kill in one day on goats with less than six weeks' growth of hair, and in 3–5 days on those with 2–5 months' growth of hair. In the flock infested with both biting and sucking lice, control of the former was achieved with 0·25 per cent. fenchlorphos in one day, and of the latter in four days. Toxaphene at 0·5 and Delnav at 0·1 per cent. failed to give control. Females treated with 0·2 per cent. Delnav and returned to their kids after four hours were subsequently found to be free of lice, but lice on the kids were not controlled; this indicates that control can be achieved only if all animals in a flock are treated. Goats from three flocks that had been treated with 0·5 per cent. fenchlorphos, 0·1 per cent. coumaphos or 0·5 per cent. Sevin were found to be free from lice when examined at the next shearing, 2–4 months later.

ACREE jr. (F.), DAVIS (P. L.), SPEAR (S. F.), LABRECQUE (G. C.) & WILSON (H. G.). **Nature of the attractant in sucrose fed on by house flies.**—*J. econ. Ent.* **52** no. 5 pp. 981–985, 2 refs. Menasha, Wis., 1959.

The presence of an unknown attractant, or factor contributed by the fly, has been demonstrated in food baits that have been visited and fed on by *Musca domestica* L., and similar results were obtained in experiments with *Phormia regina* (Mg.) [*R.A.E.*, B **44** 67]. Laboratory experiments were begun in Florida in 1953 to establish the nature of this factor, and the following is taken from the authors' abstract and discussion of the results. The attractiveness to house-flies of traps containing other house-flies feeding on sucrose is probably related to a relative-humidity gradient generated by the moisture excreted by the flies. The addition of about 6 per cent. water to sucrose increased its attractiveness to a maximum in petri-dish tests, and the resulting mixture was usually more attractive than sucrose alone that had been fed on by house-flies. No evidence was found for a volatile chemical reaction product having appreciable attractiveness. In the tests, only 10–15 per cent. of the flies were attracted to sucrose that had been fed on, indicating that the fly factor is an attractant of a low order. It seemed evident that the flies responded, not to moisture itself, but to the difference between the relative humidities generated by samples undergoing test and the relative humidity of the surrounding atmosphere.

Perry (A. S.) & Buckner (A. J.). **The metabolic fate of Prolan in a Dilan-resistant strain of house flies.**—*J. econ. Ent.* **52** no. 5 pp. 997–1002, 3 figs., 10 refs. Menasha, Wis., 1959.

The following is based mainly on the authors' abstract. A susceptible laboratory strain of *Musca domestica* L. developed resistance to Dilan [a 1:2 mixture of Prolan and Bulan] after several generations of exposure to it. Resistance to the Prolan component was much more pronounced than that to Bulan or to Dilan itself. When resistant females were treated topically with 8 μg. Prolan, 75–94 per cent. of the applied dose was recovered 2–120 hours later, and it was found that absorption was slow, only 42·5 per cent. of the dose being absorbed in 24 hours and 62·8 per cent. in 48. Analysis of the excreta of treated flies showed the presence of a neutral material, soluble in common organic solvents, with infra-red, ultra-violet and colorimetric spectra similar to those of Prolan and almost as toxic as the latter to mosquito larvae, and an acidic derivative, extractable with dilute alkali, differing from Prolan in photometric spectra and chemical properties (with no nitro group in the propane moiety), and much less toxic to mosquito larvae. Excretion of the latter compound is presumably not of importance in fly survival, since it was produced in quantity only after 12–24 hours, but excretion of the toxic material, considered to be unchanged Prolan, would be important and, in conjunction with some conversion to the non-toxic compound, a major factor in resistance. When susceptible flies were similarly treated, very little unchanged Prolan was found in their excreta.

Drummond (R. O.). **Tests with dimethoate for systemic control of cattle grubs.**—*J. econ. Ent.* **52** no. 5 pp. 1004–1006, 6 refs. Menasha, Wis., 1959.

Dimethoate has shown promise as a systemic insecticide in screening tests [*R.A.E.*, B **47** 100, 163], and killed all three larval instars of *Hypoderma lineatum* (Vill.) and *H. bovis* (Deg.) in cattle when administered orally and intramuscularly [**47** 164]. In 1957, cattle from Kerrville and College Station, Texas, and Highmore, South Dakota, were treated with it orally as a drench, intramuscularly or dermally, to determine the effective dosages. The compound, administered orally and intramuscularly at 5–20 mg. per kg. body weight, and in sprays applied at the rate of 1 or 1·5 U.S. gal. 0·25–1 per cent. emulsion per beast, gave 13–96 per cent. control of both species of *Hypoderma*, depending on the dosage. The best result was obtained with a 0·75 per cent. spray. Animals treated at the higher dosages showed symptoms of poisoning and a reduction in blood-cholinesterase activity. These results indicate that there is not an adequate margin between the dosage of dimethoate that is effective against first-instar *Hypoderma* larvae and that toxic to cattle.

Graham (A. J.) & Dudley (F. H.). **Culture methods for mass rearing of screw-worm larvae.**—*J. econ. Ent.* **52** no. 5 pp. 1006–1008, 4 refs. Menasha, Wis., 1959.

Larvae of *Callitroga hominivorax* (Coq.) have been reared successfully on artificial media [*R.A.E.*, B **29** 132]. Procedures are described by which two million flies were reared weekly for 15 consecutive weeks in a pilot plant in Florida in 1957, for sterilisation [*cf.* **44** 104] and field release. Five days each week, eggs were obtained from 20 cages, each holding 700 flies eight days old, by placing in each cage two jars each holding 50 g. medium containing a fluid thawed from ground ox heart that had been frozen; the surface of the medium was maintained at 97°F. in the cages. Cultures of 100,000 larvae were reared on a mixture of ground lean meat, blood and water in vats. Grown larvae were transferred to sand in trays for pupation, and the pupae were kept at 80°F. and 95 per cent. relative humidity until they were six days old, when they were irradiated.

For future production of 50,000,000 flies per week, a wood-supported screen cage, 6 × 6 × 4 ft., of which an entire end was a door for entering and servicing, was developed. This allowed a resting area of paper towelling, suspended from a rod, for 50,000 flies and was provided with containers for food and water along the sides of the floor, the centre of which was left free for an electrically heated tray, 60 × 10 × 1 in., containing 0·5 in. medium for oviposition.

Knapp (F. W.), Brethour (J. R.), Harvey (T. L.) & Roan (C. C.). **Field observations of increasing resistance of cattle to cattle grubs.**—*J. econ. Ent.* **52** no. 5 pp. 1022–1023, 3 refs. Menasha, Wis., 1959.

Natural resistance of cattle to larvae of *Hypoderma* spp. has been reported [*R.A.E.*, B **39** 180]. Experiments were carried out at Hays, Kansas, with cattle from New Mexico to determine whether killing the larvae in the backs produced resistance to future infestation. In November 1956, fenchlorphos (Trolene) was administered in boluses to 41 infested calves. During the winter of 1956–57, the average number of live larvae per back was 3·5 for the treated calves and 21·4 for 45 untreated ones. No further treatment was given, and the following winter (1957–58), the calves that had been treated had an average of 0·9, and the untreated calves 3·3 larvae per back. In a second experiment, in November 1957, Dowco 109 [O-methyl O-(4-tert.-butyl-2-chlorophenyl) methylphosphoramidoithioate] was administered to infested calves in boluses or as a spray. During the winter of 1957–58, the average numbers of *Hypoderma* larvae per back on the 28 sprayed animals, on the 28 treated orally and on the 26 untreated animals were 3·8, 1·8 and 4·4, respectively, and one year later (1958–59), with no further treatment, they were 12·8, 9·3 and 16·4. The population density of the adults of *Hypoderma* is greater in New Mexico than in Kansas, so that the numbers of larvae in the untreated animals in the two years were not comparable. Results from individual animals indicated that one having a large number of larvae killed in its body one year might have fewer or no larvae the following year, and one having few larvae killed might have the same or a larger number the next year. Some animals may need two or more seasonal treatments before an increase in resistance is shown.

Fay (R. W.). **Toxic effects of boron trioxide against immature stages of** *Aedes aegypti*, *Anopheles quadrimaculatus*, **and** *Culex quinquefasciatus*.—*J. econ. Ent.* **52** no. 5 pp. 1027–1028, 1 ref. Menasha, Wis., 1959.

As borax has been found to prevent the development of mosquito larvae [*R.A.E.*, B **16** 142], laboratory evaluations were made of the immediate toxic effects of boron-trioxide solutions on the eggs, first-, second- and third-instar larvae and pupae of *Aëdes aegypti* (L.), *Anopheles quadrimaculatus* Say and *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.). A concentrate containing 30,000 parts metaboric acid per million was prepared, and aliquot parts of this were diluted to form the test solutions. *Aëdes* laid eggs that hatched after more than 72 hours in a solution containing 8,000 p.p.m. metaboric acid. Oviposition tests with adults of *Anopheles* and *Culex* did not give conclusive results. Eggs of all three species, laid in tap water, hatched in solutions of 2,000, 4,000 and 8,000 p.p.m. metaboric acid. Within 24 hours, all the newly-hatched larvae were dead in all three concentrations for *Culex*, in the 4,000 and 8,000 p.p.m. solutions for *Aëdes*, and in the 8,000 p.p.m. solution for *Anopheles*. At 48 hours, only larvae of *Anopheles* persisted in the 2,000 p.p.m. solution. The solutions killed all second-instar larvae of *Anopheles* and *Culex* in 24 hours at 500 and 4,000 p.p.m., respectively, and of *Culex* and *Aëdes* in 48 hours at 2,000 and 3,000 p.p.m., respectively. Tests with third-instar larvae showed the same relative susceptibilities of the three species, but concentrations of 4,000 p.p.m. were needed to kill all the larvae of *Anopheles* and *Aëdes* in 24 hours, and of 10,000 p.p.m. for *Culex*. No reduction in the toxic effects of metaboric acid was shown when humus was added to the test solutions. Pupae, less than one day old, were less affected by metaboric acid than were the larvae, 6,000, 16,000 and 12,000 p.p.m. being needed for complete kills with *Anopheles*, *Aëdes* and *Culex* respectively. The effects of prolonged exposure were investigated by rearing newly-hatched larvae in various concentrations of metaboric acid and determining the number of adults that emerged. Concentrations of 10, 25, 50 and 100 p.p.m. metaboric acid did not reduce the number of adults of *Aëdes* or *Culex* significantly, but at 250 p.p.m. only 1 per cent. of *Aëdes* and 3 per cent. of *Culex* reached the adult stage. At 50 p.p.m. metaboric acid, only 2 per cent. of *Anopheles* larvae reached maturity; but 25 p.p.m. had no effect.

Drummond (R. O.) & Moore (B.). **Ronnel sprays for systemic control of cattle grubs.**—*J. econ. Ent.* **52** no. 5 pp. 1028–1029, 5 refs. Menasha, Wis., 1959.

Sprays of fenchlorphos (ronnel) have been used for the control of *Hypoderma* larvae on cattle [*cf. R.A.E.*, B **46** 89, 165]. Tests were carried out at Kerrville, Texas, with sprays of this insecticide for the systemic control of *H. lineatum* (Vill.) and *H. bovis* (Deg.) on a small number of cattle from South Dakota. In November 1957, four beasts with long winter hair were sprayed with 2·5 per cent. wettable fenchlorphos at 1½ U.S. gal. per animal. They and 20 untreated animals were examined for *Hypoderma* larvae five times during January–April 1958. No larvae appeared in the backs of the treated cattle whereas the untreated ones had an average of 36·3. In May 1958, 29 beasts with short summer hair were sprayed with a 1·75 per cent. wettable technical fenchlorphos at 1 U.S. gal. per animal. A first examination in October showed an average of 2·2 *Hypoderma* larvae per treated, and 1·6 per untreated animal. At a second examination in December, treated cattle had an average of 4, and untreated cattle an average of 10·7 larvae. The effectiveness of applying the same amount of toxicant in lower concentrations at intervals was tested. Three groups of cattle (15, 15 and 18 in number) were sprayed with technical fenchlorphos at 0·25, 0·5 or 0·75 per cent. Applications, timed as needed for the control of *Siphona irritans* (L.) and ticks, were applied in the form of suspensions on two occasions in May and on one in July, and of an emulsion in June, each animal receiving 1 U.S. gal. spray. The cattle were examined at monthly intervals from September to January. No larvae were found in the backs of animals treated with 0·75 per cent. fenchlorphos, but the lower concentrations gave less than 15 per cent. control.

Sabrosky (C. W.). *Musca autumnalis* **in the central States.**—*J. econ. Ent.* **52** no. 5 pp. 1030–1031, 3 refs. Menasha, Wis., 1959.

Since its collection in Nova Scotia in 1952 [*R.A.E.*, B **43** 55], *Musca autumnalis* Deg. has been found in a number of places in the north-eastern United States. Recently it was recorded from two localities in northern Virginia, where it occurred in houses in December and January. In June 1959, it was taken in Ohio, where there was a severe infestation on cattle in the field, and in Indiana, where the flies were found round the eyes of cattle in pasture. *M. autumnalis* is an intermediate host of *Thelazia rhodesi* [*cf.* **39** 205; **42** 97], a nematode infesting the eyes of mammals that is prevalent in the Soviet Union and infects a high proportion of cattle in some areas.

Jackson (J. B.), Ivey (M. C.), Roberts (R. H.) & Radeleff (R. D.). **Residue studies in sheep and goats dipped in 0·025% lindane.**—*J. econ. Ent.* **52** no. 5 pp. 1031–1032, 2 refs. Menasha, Wis., 1959.

To supplement data obtained at Kerrville, Texas, on residues of γ BHC (lindane) in cattle, four sheep and four goats were dipped in 0·025 per cent. wettable γ BHC, and fat samples were taken from each animal a week before and on three further occasions in the 12 weeks after treatment and analysed by a modification of the Schechter-Hornstein colorimetric method. Slightly higher residues of γ BHC were found in the sheep than in the goats. The residue was highest two weeks after dipping, averaging 4·22 parts per million in sheep, and 2·67 p.p.m. in goats. There was no residue 12 weeks after treatment. No symptoms of abnormal conditions were observed in the animals.

Bursell (E.). **The water balance of tsetse pupae.**—*Phil. Trans.* (B) **241** no. 680 pp. 179–210, 1 pl., 14 figs., 31 refs. London, 1958.

The pupal period of *Glossina morsitans* Westw., which is defined as the interval between the hardening and darkening of the skin of the third-instar larva to form the puparium and the emergence of the adult, can be divided into a number of different stages on the basis of anatomical changes. At 25°C. [77°F.] the period lasts about 30 days. For the first day, the larva remains quiescent in the third instar and water is lost relatively rapidly, in part by transpiration through the puparium and in part through the supernumerary stigmata of the polypneustic lobes, and loss of weight is directly proportional to the saturation deficiency of the atmosphere. From the second to the fourth day, inclusive, the larva is in the fourth instar and rates of transpiration are somewhat lower [*cf.* *R.A.E.*, B **47** 39] because a second integument has been deposited inside the puparium, but water is lost by excretion through the anus as well as by transpiration; this excretory loss is regulated so that, as more water is transpired, less is excreted. The moult to the actual pupal stage occurs on about the fifth day; a few days later, the hypodermis retracts from the pupal skin and the deposition of the adult cuticle begins. After the formation of the very impermeable pupal skin, the rate of transpiration decreases substantially. At this stage, water is lost also through the pupal spiracle, but this loss is under active control, the rate being a function of the water content of the pupa. From the air space, water vapour diffuses out through the puparium, the combined rate of loss being about a third of that which characterises the larval stages. A few days before emergence, the pupal skin dries out and its permeability increases; spiracular control ceases at the same time, so that rates of water loss during this period are high. The regulation of excretory loss and of spiracular loss, combined with extremely low permeability of the membranes, makes the pupa of *G. morsitans* highly resistant to desiccation; and pupal development can be completed at relative humidities as low as 10 per cent. As the rate of transpiration during the middle period of pupal development is a function of the humidity to which the earlier stages have been subjected, it is possible to determine the humidity of the pupal site by using the pupa itself as a hygrometer. The transpiration rates of pupae brought in from the field are compared with those of laboratory-bred pupae maintained at known humidities during the early stages. Laboratory pupae are smaller than wild ones, but the rate of water loss during the mid-pupal period can be expressed in terms of surface area, and is then independent of size.

It is shown that in areas with a prolonged dry season, the relative humidity to which pupae of species such as *G. morsitans*, *G. swynnertoni* Aust. and *G. pallidipes* Aust. are subject under natural conditions may fall to about 40 per cent., and if pupal sites are exposed to the action of grass fires, even lower humidities may be experienced. A close correlation is shown to exist between the resistance of the pupae of different species to desiccation and the habitat in which they occur, and it is suggested that the water balance of the pupa may have been an important limiting factor in the invasion of semi-arid and arid habitats. The development of resistance to desiccation in tsetse pupae has involved a decrease in the permeability of puparium and pupal skin, a decrease in the size of respiratory lobes and an increase in the percentage loss of water that can be tolerated before development stops.

Bursell (E.). **Determination of the age of tsetse puparia by dissection.**—*Proc. R. ent. Soc. Lond.* (A) **34** pt. 1–3 pp. 23–24, 3 refs. London, 1959.

A method of determining the age of *Glossina* puparia without reference to the date of adult emergence is necessary when puparia collected in nature are subjected to experimental treatment causing death. Puparia of *G. morsitans* Westw. derived from larvae deposited in the laboratory and maintained at a constant temperature (25·5°C. [77·9°F.]) were therefore dissected, and the durations of the different stages, and thus their mean ages from deposition, were observed. The three main stages distinguished [see preceding abstract], quiescent third-instar larva, fourth-instar larva, and pupa and pharate adult [adult still enclosed in the pupal skin] lasted 1, 3 and 23 days, respectively, and the mean ages of the first two were 1 and 2 days, respectively. It was found possible to subdivide the third stage on the basis of pigmentation, the phases recognised with their duration and (in brackets) mean age, both in days, being no pigmentation, 7 (8), eyes only pigmented with (a) eyes yellow, 2 (12), or (b) eyes reddish-brown, 6 (16), eyes pigmented and bristles black, 3 (21), and general integument pigmented with (a) pupal skin moist and entire, 3 (24), or (b) pupal skin dry and adhering to puparial shell, 2 (26).

Bursell (E.). **The water balance of tsetse flies.**—*Trans. R. ent. Soc. Lond.* **111** pt. 9 pp. 205–235, 5 figs., 32 refs. London, 1959.

The following is almost entirely based on the author's summary. A method is described for estimating the water loss of resting tsetse flies. Corrections for size were made on the basis of residual dry weight, both fresh weight and thoracic surface having been found to be unsatisfactory measures of size. The powers of resistance to desiccation of different species were determined by consideration of their resting loss in relation to the quantity of expendable water reserves. There was very little variation from species to species and no correlation between resistance to desiccation and habitat, a xerophilic species showing higher rates of loss than any of the hygrophilic ones studied. It is tentatively concluded that the water balance of the adult tsetse has been no obstacle to the invasion of semi-arid and arid habitats and, in view of the very close relation between resistance to desiccation and habitat in the pupa [*R.A.E.*, B **49** 14], it seems very probable that the process of selection has been operative on the pupa. It appeared that, in dry air, fat reserves would not become exhausted in any of the species examined before death by desiccation supervened.

Releases were made of newly emerged adults of *Glossina morsitans* Westw. in the natural habitat of the latter at Shinyanga, Tanganyika. Water, fat and residual dry weight of the recaptured flies were determined and, by comparison with a sample killed within an hour of emergence, the rate of water loss and of fat consumption was measured for successive days of teneral life. The rates of water loss occurring in the field were compared with the rates of water loss while at rest determined in the laboratory under the same conditions of mean temperature and humidity. Except for a single batch of recaptures, the flies recovered from the field had lost water at rates lower than those shown by resting flies in the laboratory, in spite of the fact that the rate of fat consumption of the released flies showed that they had been active for some of the time before recapture. It is suggested that the anomaly may be accounted for on the assumption that flies make use of microclimates of high relative humidity, and this possibility is considered in the light of field observations [**46** 37].

Wallace (C. R.). **Report on an investigation of agricultural pests in St. Helena, 1957–1959.**—ii + 54 pp., 33 refs., multigraph. [London] Colon. Off., 1960.

During a survey of pests in St. Helena [*cf. R.A.E.*, A **49** 7], a few that attack livestock were encountered. They comprised two ticks, *Boophilus decoloratus* (Koch) and *Rhipicephalus evertsi evertsi* Neum. on cattle, *Stomoxys calcitrans* (L.), which annoyed cattle and donkeys, *Melophagus ovinus* (L.) on sheep, *Lucilia sericata* (Mg.), which though present has not been reported as infesting sheep. and *Echidnophaga gallinacea* (Westw.) on poultry. A few arthropods of medical interest recorded include *Culex pipiens fatigans* Wied., which was taken in three localities in the green belt.

GARNHAM (P. C. C.), LAINSON (R.) & COOPER (W.). **The complete life cycle of a new strain of** *Plasmodium gonderi* **from the drill** (*Mandrillus leucophaeus*), **including its sporogony in** *Anopheles aztecus* **and its pre-erythrocytic schizogony in the rhesus monkey.**—*Trans. R. Soc. trop. Med. Hyg.* **52** no. 6 pp. 509–517, 2 pls. (1 col.), 11 refs. London, 1958.

A description is given of the blood stages of a new strain of *Plasmodium gonderi* isolated from a drill (*Mandrillus leucophaeus*) in the British Cameroons. This provides a new host record for *P. gonderi* in a locality about 1,000 miles from that in which it was previously known to occur. There was cross immunity between the new strain and an old one from mangabey (*Cercocebus galeritus agilis*). Viable sporozoites were readily produced in *Anopheles aztecus* Hoffm. and developed in a smaller percentage of females of *A. labranchiae atroparvus* van Thiel (*maculipennis atroparvus* van Thiel) [*cf. R.A.E.*, B **28** 148]. In both mosquitos, they reached the salivary glands in nine days. The parasite was readily transmitted to rhesus monkeys [*Macaca mulatta*] by intravenous inoculation of sporozoites in suspensions of salivary glands. The pre-erythrocytic schizonts developed in the parenchyma cells of the liver and became mature and ruptured in just under eight days.

ELLIOTT (R.). **A method for the investigation of susceptibility to insecticides in** *Anopheles* **larvae.**—*Trans. R. Soc. trop. Med. Hyg.* **52** no. 6 pp. 527–534, 1 graph, 10 refs. London, 1958.

The difficulties associated with the testing of insecticides on Anopheline larvae are discussed, especially those applying to the small tropical species that develop rapidly, and a method is described that is distinguished principally by exposure for only one hour in strong solution followed by a waiting period of five hours for recovery or death. Like a method developed by J. C. Jones [*cf. R.A.E.*, B **47** 53], this method does away with a prolonged exposure period without food in which stress due to starvation is added to that due to the toxicant, and obviates the considerable deterioration to which weaker solutions are subject, but it relates mortality to concentration in the usual way instead of to time, as in Jones' method. The third instar was used, as it is shorter in duration than the fourth and more uniform in its reactions. Eight insecticides were tested by the new method against larvae of two strains of *Anopheles gambiae* Giles, one of which was resistant to dieldrin [**45** 68], and one of *A. labranchiae atroparvus* van Thiel (*maculipennis atroparvus* van Thiel) and the results were evaluated statistically. The latter mosquito and the susceptible strain of the former had a similar pattern of response to the whole range of insecticides, except that the *gambiae* strain showed unusual tolerance towards diazinon, but the resistant *gambiae* strain departed markedly from the pattern in its complete lack of susceptibility to the cyclodiene insecticides (dieldrin and toxaphene) and greatly reduced susceptibility to γ BHC and DDT. Of the organophosphorus compounds, only parathion showed promise for the control of resistant larvae of *A. gambiae*.

It is suggested that the test method, which was highly sensitive to small differences in susceptibility and gave consistent and reproducible results, may prove to be a useful supplement to the established methods of testing for the presence of insecticide resistance in mosquitos, and for its measurement when found.

LAURENCE (B. R.) & SMITH (S. A.). **The breeding of** *Taeniorhynchus* **(subgenus** *Mansonioides*) **mosquitoes in the laboratory.**—*Trans. R. Soc. trop. Med. Hyg.* **52** no. 6 pp. 518–526, 2 pls., 2 figs., 8 refs. London, 1958.

LAURENCE (B. R.). **The biology of two species of mosquito,** *Mansonia africana* **(Theobald) and** *Mansonia uniformis* **(Theobald), belonging to the subgenus** *Mansonioides* **(Diptera, Culicidae).**—*Bull. ent. Res.* **51** pt. 3 pp. 491–517, 9 figs., 66 refs. London, 1960.

Mosquitos of the genus *Mansonia* (*Taeniorhynchus*) are difficult to rear in the laboratory, but *M. uniformis* (Theo.) has been reared in Malaya with dried guineapig dung as larval food [*R.A.E.*, B **47** 6] and larvae of *M. africana* (Theo.) have developed on powdered dog biscuit [**46** 144–145]. Both these species and *M. annulifera* (Theo.) were subsequently maintained in the laboratory in London for over a year and for 12 or more generations with a surplus of adults for experimental use. The methods used are described in the first paper, and observations made during the maintenance of the colonies of *M. africana* and *M. uniformis*, which often occur together in Africa, are recorded in the second.

Adults were kept at 26–30°C. [78·8–86°F.] and 70–90 per cent. relative humidity in cages measuring 10 × 10 × 10 in., in which they mated readily and fed on fresh apple and on sugar solution from a cotton-wool pad. Blood-meals from anaesthetised guineapigs or the human hand were offered once a week and readily accepted. Females were transferred after feeding to a 'nursery' cage in which the same conditions were maintained as in the stock cage, and 4–6 days later to cylindrical oviposition jars 4 in. high and about 2½ in. in diameter containing floating plants of *Salvinia*, *Lemna* or *Azolla*. Females of *M. africana* and *M. uniformis* oviposited readily, and those of *M. annulifera* more reluctantly, on these and fed again almost at once, some surviving to lay one or more further egg-masses. Females left in the nursery cage beyond the sixth day after feeding died within the next few days. Plants bearing egg-masses were kept in tap water until the larvae hatched, usually 5–6 days after oviposition in *M. uniformis* and *M. annulifera* and a day later in *M. africana*. In successful cultures, pupae appeared 16–20 days after the eggs hatched, and adults emerged 25–40 days after oviposition.

Experiments were carried out to compare various culture media (a concentrated infusion of guineapig dung, a more dilute infusion with supplements, and a concentrated infusion of dog biscuit [*cf.* **46** 145]) and various plants (*Salvinia* and British aquatic grasses) and brown paper [*cf.* **33** 121] to which the larvae could attach themselves. Numerous bacteria, Protozoa and other fauna developed in the dung infusion, but frequent replacement was necessary to maintain the micro-organisms, until it was found that the addition of yeast was also effective. The *Salvinia* survived longer in the dilute infusion than in the concentrated, which had no advantages. Two grasses, *Glyceria maxima* and *Phalaris arundinacea*, gave good results, and lived for two weeks or more in the cultures, but their death might pass unnoticed and prove fatal to the attached larvae. The use of "wet strength" brown paper impregnated with resins, partially renewed every 3–4 days, gave more uniform results and obviated the difficulty of obtaining enough plants to maintain large cultures. Equally successful results (about 27 per cent. of newly hatched larvae reaching the adult stage) were obtained with an infusion of dog biscuit in water (6 g. in 500 cc.) used at 1:1 or 1:5 in tap water or an infusion of guineapig dung (120 pellets in 1,500 cc.) diluted 1:5 with tap water. Both were stabilised by a turf and maintained by the addition of dog biscuit to the first or yeast to the second every 2–3 days. *Salvinia* was provided for pupation as there was considerable mortality if larvae pupated on paper that had been standing in water for three days or more. Mortality in the cultures was greatest soon after hatching, with a further appreciable loss at pupation.

The following is substantially the author's summary of the second paper. *M. uniformis* occurs from China to Africa, whereas *M. africana* is restricted to continental Africa. The two species did not interbreed in the laboratory; cross-mating was possible but no insemination occurred. Strains of *M. uniformis* from Uganda, Ceylon and Malaya were found to be interfertile, but crosses between the African and the other strains, especially, showed reduced fertility in the eggs produced and thus some evidence of speciation. Adults of the two species behave in the same way in mating, feeding (in both field and laboratory) and oviposition. Both species mated readily in small cages. Females took their first blood-meal about 24 hours after emergence and subsequent ones immediately after each oviposition, 3–5 days after the previous blood-meal. *M. uniformis* was more active directly after a blood-meal. The females laid their eggs on the undersides of most surfaces floating on the water, such as leaves and disks of cork or paper. They preferred leaves with the underside meeting the surface of the water at an angle rather than leaves floating flat on the surface. Females of *M. africana* were more sensitive to pollution by organic material, and those of *M. uniformis* showed a greater visual sensitivity. Females of *M. africana* lived for up to 30 days and those of *M. uniformis* for up to 40 days. Both species were susceptible to low humidities and few males or unfed females survived exposure to 70 per cent. relative humidity for 24 hours at 27–29°C. [80·6–84·2°F.].

The bionomics of the early stages was almost identical in the two species, although development was slightly more rapid in *M. uniformis*. At 27–29°C., the eggs of *M. uniformis* hatched in 5–6 days, 24 hours before those of *M. africana*. There was evidence that the period from hatching to emergence of the first adult was also shorter in *M. uniformis*, with a mean of 24·3 days, compared with 25·5 days in *M. africana*, although larvae reared together sometimes gave rise to adults at the same time and in equal numbers. The larvae also differed in their resistance to high temperatures, and above 40°C. [104°F.], some larvae of *M. uniformis* survived exposures lethal for *M. africana*. The larvae of both are filter feeders and feed on the same type of food. They attached themselves readily to most plants and other materials containing air, such as paper, placed in the water, provided that food in the form of bacteria, yeasts and other organisms was also present. Any air store that can be penetrated by the larval siphon is used, and there was no selection of particular plant species for attachment. The larvae survived in tap water, respiring at the surface, for 24 hours, but usually could not live under these conditions for 48 hours. If food was present, they sometimes lived longer, attached to the bacterial film at the surface of the water, but most larvae died under these conditions while moulting. The pupae can develop attached to plants or to paper. Shortly before emergence, which takes place about three days after pupation, they detach themselves and float at the surface, and up to 51 per cent. of pupae that did so 1–2 days before emergence developed normally. The pattern of emergence is the same in *M. africana* and *M. uniformis*.

The implications of the similarity in the bionomics of the two species are discussed with reference to possible competition between them. It is concluded that *M. africana* has evolved in isolation in Africa and that *M. uniformis* is most probably a more recent invader. Differences in the behaviour of the females in the selection of breeding places may determine the local distribution of the two species, and there is some evidence that their habitat ranges do not completely coincide.

Chapman (R. F.). **A note on** *Glossina medicorum* **Aust. (Diptera) in Ghana.**—*Bull. ent. Res.* **51** pt. 3 pp. 435–440, 1 pl., 2 graphs, 7 refs. London, 1960.

Glossina medicorum Aust. was attracted to a vehicle travelling slowly through thicket near Accra, Ghana, and considerable numbers were collected in this way, mainly at daybreak, and more commonly when the thicket began to open before giving place to grassland. The habitat was unusual in that the thicket rarely exceeded 15 ft. in height and big trees were entirely absent [*cf. R.A.E.*, B **20** 124]. Grassy open spaces within the thicket provided the feeding grounds, and bushbuck [*Tragelaphus scriptus*] was apparently the commonest of possible hosts [*cf.* **48** 157], a list of which is given. The thicket extends from Takoradi almost to the Volta River, and the fly probably occurs throughout it wherever suitable feeding grounds are available. As it appears to be a potentially important vector of trypanosomes [**40** 107; **48** 42, 157], it might be a source of danger in any scheme to introduce cattle to the parts of the Accra plain adjacent to the thicket. There was some suggestion of an association between the abundance of the fly and rainfall in 1958 but not in 1959; the size of the flies was inversely correlated with the saturation deficit of the previous two months.

Kettle (D. S.). **The flight of** *Culicoides impunctatus* **Goetghebuer (Diptera, Ceratopogonidae) over moorland and its bearing on midge control.**—*Bull. ent. Res.* **51** pt. 3 pp. 461–489, 1 pl., 9 figs., 21 refs. London, 1960.

The following is virtually the author's summary. In the summer of 1958, experiments were carried out in the neighbourhood of Brunston Muir, Midlothian, 11 miles south-east of Edinburgh, to measure the flight range of *Culicoides impunctatus* Goetgh. from its breeding site in the direction of the prevailing south-westerly wind. More than 23,000 individuals of *Culicoides*, of which 20,105 were of *C. impunctatus* (7,207 males and 12,898 females), were caught in 36 adhesive traps exposed for six weeks from 27th May to 7th July. Eleven of the traps were arranged in a line over a distance of 1,200 yards. The catch of females did not alter for 400 yards, then decreased to a new level, which remained constant from 600 to 1,200 yards. This decrease was associated more with the absence of livestock after 550 yards than with any density/distance regression. The distribution of males was similar to that of the females. Ten more traps stretched over a distance of 750 yards and again no regression was discernible. The female distribution was affected more by the availability of hosts than by distance from the breeding site. The male distribution here was different. Males appeared to pass less readily through a gap in a narrow belt of woodland than did the females. Five traps arranged at right angles to the prevailing wind over a distance of 200 yards recorded no difference in catches of either sex over this distance. However, in this experiment, there were abundant hosts available in the neighbourhood of all five traps, and during the period of observation the wind showed considerable deviation from the normal south-westerly direction. Ten more traps were arranged in two parallel lines between a breeding site and a farm 260 yards away. There was an increase in the catch of both sexes in the middle of each row, where the traps were in a pasture field, owing to the presence of domestic animals.

The relevance of these results to midge control is discussed, in particular the change in estimate of the flight range from 200 yards, which was formerly regarded as the practical limit of flight [*R.A.E.*, B **44** 198], to three-quarters of a mile or more. The flight range is dependent upon wind carriage and the availability of acceptable hosts on the way. If suitable hosts are found, few females fly further. The observations on males of *C. impunctatus* are discussed from the point of view of male behaviour and also from their bearing on the explanation of variations in sex ratio that have been recorded among populations of *C. impunctatus* by use of the same technique. The distribution of *C. pulicaris* (L.) over Brunston Muir and its environs is given. It was present in low density on the Muir but was more abundant in pasture fields containing large domestic animals.

Gostick (K. G.) & Hewlett (P. S.). **Killing house-flies,** *Musca domestica* **L., by means of hanging drops of insecticide.**—*Bull. ent. Res.* **51** pt. 3 pp. 523–532, 3 figs., 12 refs. London, 1960.

The following is substantially the authors' summary. Basic laboratory investigations were carried out on a method for giving house-flies (*Musca domestica* L.) relatively large doses of insecticide, with a view to possible applications in controlling, or preventing the appearance of, resistant strains of flies. The principle is that a relatively large drop of mineral oil will hang on the lower end of a thin vertical or near-vertical wire (*e.g.*, a drop of up to 3 µl. on a wire 0·3 mm. in diameter), and a fleeting contact of a fly with the drop will generally transfer to the surface of the fly a substantial volume of oil. For investigational purposes, pins were inserted obliquely into rods (*e.g.*, about 700 pins into a rod 60 cm. long), and drops of up to about 1 µl. were formed on the ends of the pins by dipping the pin-bearing rods into solutions of insecticide in oil. In a typical experiment, a rod with suspended drops was hung vertically from the ceiling of a chamber of 18 cu. ft. capacity; flies released in the chamber collected doses of insecticide when attempting to alight on the rod.

A suitable oil solvent was selected by giving flies access to rods bearing drops of different oils containing pyrethrins, and the volumes of the oils on individual flies knocked down were estimated. It was concluded that Shell Risella oil 17 was a better oil for the purpose than Liquid Paraffin B.P. as the quantity of the former retained by the flies was about four times that of the latter; odourless kerosene was too volatile. High mortalities occurred in batches of flies with access to insecticidal drops under conditions in which the flies were flying actively; the expenditure of insecticide was low. As expected, low mortalities were obtained in batches kept in darkness, when flight activity was reduced. Probably many compounds not ordinarily employed as insecticides could be used as toxicants in hanging drops of oil for killing flies. For example, drops of 10 per cent. w/v 1-methylnaphthalene in Risella oil produced high mortalities, and maintained high insecticidal potency for four weeks when stored at 27°C. [80·6°F.].

Morris (K. R. S.). **Trapping as a means of studying the game tsetse,** *Glossina pallidipes* **Aust.**—*Bull. ent. Res.* **51** pt. 3 pp. 533–557, 1 pl., 2 figs., 13 refs. London, 1960.

The following is mainly based on the author's summary. In an area of sleeping sickness due to *Trypanosoma rhodesiense* in Uganda [*R.A.E.*, B **33** 101], Morris's animal traps [**37** 110] were used in 1956–57 to study the activity and the relations with habitat and hosts of the vector, *Glossina pallidipes* Aust., a tsetse difficult to sample by conventional fly-round methods. This type of trap was found to give samples both numerically greater and more truly representative of the tsetse population present than did either fly-boys or a bicycle-screen method used in Uganda. Black traps showed an over-all superiority over brown traps, greatest during the rains and disappearing in the dry season. This was related to the dependence of the trap's attraction on its resemblance to a natural host. The greater conspicuousness of the black trap was of more advantage during the rains when vegetation was denser. A trap of double linear dimensions made catches three times greater than those in standard traps.

Since trapping provided a standard measure of fly incidence, allowing comparison between different times and places of catching, it was used for determining the habitat preferences of *G. pallidipes*, its activity periods throughout 24 hours, and the influence of the presence of its hosts. In this part of Uganda, the true habitat of *G. pallidipes*, in which the communities reach their greatest numbers, is the narrow zone of broken thicket between the forest and the open grassland of the valleys. Young, regenerating forest with broken canopy forms a secondary and less favoured habitat, but high closed-canopy forest is not occupied. Activity, as measured by three-hourly visits to the traps, was greatest in the middle of the day, the peak occurring between 10 a.m. and 1 p.m. in females and in the subsequent period in males. Evidence was obtained indicating that swarms of *G. pallidipes*, consisting of at least 200–300 flies of both sexes, collect around and follow herds of elephants passing through fly-infested country.

In a settlement of some 400 people, in a belt of *G. pallidipes* in an area in South Busoga officially closed to human occupation on account of sleeping sickness, a striking reduction in the numbers of tsetse took place during the first eight weeks of trapping. This can be explained on the assumption that there are resident anthropophilous flies within and around the settlement, which were rapidly caught by the 18 traps in operation. After the initial reduction, flies continued to intrude in very small numbers into the settlement from the surrounding fly-belt, and the surprising capture of greater numbers of these flies in open fields of low crops and in the open compounds of the houses than in the apparently more attractive cover of shady banana plantations is explained by the presumption that they are hunting for food or mates. The fact that such a settlement automatically lowered the numbers of tsetse in its immediate area in comparison with undisturbed fly-belt, gave support for a project for reclaiming a strip of country from *G. pallidipes* by means of settlement alone. The use of traps demonstrated that marked local reductions of fly incidence took place when the South Busoga Resettlement Scheme was put into operation, and provided information of value for wider developments on similar lines.

BURSELL (E.). **The effect of temperature on the consumption of fat during pupal development in** *Glossina*.—*Bull. ent. Res.* **51** pt. 3 pp. 583–598, 5 graphs, 22 refs. London, 1960.

The larvae of *Glossina* are nourished by a maternal secretion rich in lipoid and at the time of deposition contain extensive reserves of chloroform-soluble substances, referred to as fat. This constitutes the sole source of energy during pupal development, and that which remains provides most of the food available to the fly before its first blood-meal. Any factor, therefore, that affects fat consumption during development will influence the length of life of the newly emerged fly and hence its chance of obtaining a blood-meal. To estimate the effect of temperature on fat consumption during pupal development, the fat content of newly emerged flies was determined after development at different temperatures and was compared with that of the presumptive teneral (the newly deposited larva without those parts destined to form the puparial shell, the fourth-instar exuviae and the pupal skin). For practical purposes, it was found to be possible to equate the residual dry weight of the teneral with that of the presumptive teneral, and formulae for the calculation of the fat content of the presumptive teneral on this assumption are given.

The following is based on the author's summary of the results of the observations. From experiments on *G. morsitans* Westw. at a number of different temperatures, it was found that the amount of fat consumed was least at 22–24°C. [71·6–75·2°F.]. With a knowledge of the duration of the pupal period at different temperatures, the rate of fat consumption could be calculated. The logarithm of this rate was found to be linearly related to temperature. The occurrence of an optimum temperature in respect of fat consumption thus reflects the fact that at high temperatures the rate of fat consumption is greatly increased without a corresponding reduction in the duration of the pupal period, whereas at low temperatures the pupal period is very greatly lengthened without a corresponding decrease in the rate of fat consumption. It was found that smaller individuals emerge with relatively less fat than larger ones, and the evidence suggests that this is because the amount of fat laid down at the beginning of pupal development is relatively small in small individuals. The data obtained with *G. morsitans* were extended to cover a number of other species on the assumption that the logarithm of metabolic rate is linearly related to the logarithm of size. The relation between size and fat content in *G. swynnertoni* Aust., *G. palpalis* (R.-D.) and *G. pallidipes* Aust. conforms with that established for *G. morsitans*, the smaller species having relatively small fat reserves. *G. longipennis* Corti and *G. fuscipleuris* Aust. have less fat than would be expected from this relation, and *G. austeni* Newst. has far more, the smaller size of this species being necessarily accompanied by a change in the proportion of fat to residual dry weight laid down in pregnancy, without which the smaller individuals would be unable to complete their development even under optimal conditions.

An estimate was made of the size that a tsetse must be if it is to complete its development and live to obtain its first blood-meal at different temperatures. Comparison of these estimates with the size distribution of *G. morsitans* and *G. swynnertoni* in cold and hot seasons suggest that exhaustion of pupal fat reserves may play a part in limiting the distribution of these species under extreme climatic conditions. The logarithm of metabolic rate extrapolates to zero at about 4°C. [39·2°F.]; at temperatures lower than this, the mortality of pupae increases greatly with duration of exposure. It is suggested that 4°C. may represent the lower threshold for the process of development, but that development could never proceed to completion at this temperature because fat reserves would be inadequate.

Yeo (D.) & Simpson (H. R.). **The effect of repeated insecticidal applications on a natural tsetse population.**—*Bull. ent. Res.* **51** pt. 3 pp. 631–637, 9 refs. London, 1960.

The following is virtually the authors' summary. By the use of a deterministic model of a population of *Glossina*, theoretical calculations were made of the effect of repeated applications of a non-persistent insecticide on a natural population. It was assumed that the insecticidal applications instantaneously reduced the adult population, and that there was no lasting effect. For the numerical work, it was assumed that a female tsetse had a pupal period of four weeks and an average expectation of life of six weeks and produced its first larva three weeks after emergence and subsequent ones at intervals of $1\frac{1}{2}$ weeks. Results were calculated for kills of females varying from 50 to 95 per cent. per application, for series of up to eight successive applications, and for intervals between successive applications of 1–6 weeks and also for the case when the population is allowed to become stable between applications. With high kills per application, very drastic reductions are to be expected from 6–8 applications, and the theory predicts the best results for an interval between applications of four weeks. An attempt is made to relate the theoretical results with those achieved in actual field experiments. The reductions in population were sometimes very much smaller than those predicted by the theory; some tentative, but not entirely satisfactory, suggestions are made to account for these anomalous results.

Liu (Chung-wan), Chang (Sing), Cheng (Yun-kai) & Wang (Yi-min). **Studies on vectors of Japanese B encephalitis virus in Peking. II. Studies on the blood feeding habits of common species of mosquitoes in Peking.** [*In Chinese.*]—*Acta ent. sin.* **9** no. 1 pp. 51–56, 10 refs. [Peking] 1959. (With a summary in English.)

In this second paper of a series [*R.A.E.*, B **48** 223], investigations in Peking by means of the precipitin test are recorded showing that *Culex pipiens pallens* Coq. feeds most frequently on man but also on poultry and domestic animals (especially horses), *C. tritaeniorhynchus* Giles mostly on horses and other equines, but also on cows and pigs and less frequently on man, and *Anopheles hyrcanus sinensis* Wied. and *Aëdes vexans nipponii* (Theo.) mostly on cows. In view of these and other studies, it is considered that the first two may be important vectors of Japanese B encephalitis in Peking.

Wu (Chia-yung). **A preliminary mosquito survey in Chinping, Kweichow Province.** [*In Chinese.*]—*Acta ent. sin.* **9** no. 1 pp. 57–65, 3 figs., 26 refs. [Peking] 1959. (With a summary in English.)

A survey of mosquitos in Chinping, Kweichow Province, in July–August 1956 showed the presence of 32 species, including six of *Anopheles*. Notes on them are given.

Yü (En-shu) & Wu (Hsien-yi). **Study on morphological and biological differences between two types of** *Trombicula deliensis* **Walch.** [*In Chinese.*]—*Acta ent. sin.* **9** no. 1 pp. 66–74, 1 fig., 6 refs. [Peking] 1959. (With a summary in English.)

Two types of *Trombicula deliensis* Walch were found on rodents in Ping-Tang Island, off the coast of Fukien, and reared in the laboratory; both sometimes occurred on the same animal. Differences in their morphology and bionomics are described. One was more prolific and developed more rapidly than the other.

Liu (En-poo) & Chen (Chien-shing). **A preliminary report on the study of the hibernation of** *Anopheles hyrcanus* **var.** *sinensis* **in Chia-Hsing, Chekiang.** [*In Chinese.*]—*Acta ent. sin.* **9** no. 1 pp. 75–84, 3 figs., 17 refs. [Peking] 1959. (With a summary in English.)

Investigations in 1956–57 showed that the principal hibernation sites of *Anopheles hyrcanus sinensis* Wied. in Chia-Hsing District, Chekiang, were deserted forts, dens or pits. No larvae hibernated, but it is believed that eggs can do so. Two types of this mosquito were observed.

Hsu (Kuo-chin) & others. **A report on the species and ecology of mosquitoes in Chengtu, Szechwan, China.** [*In Chinese.*]—*Acta ent. sin.* **9** no. 1 pp. 85–92, 1 graph, 18 refs. [Peking] 1959. (With a summary in English.)

A survey of mosquitos in Chengtu, Szechwan, in 1954–56, showed that 31 species were present, including seven species or varieties of *Anopheles*. Notes on bionomics and hibernating habits are given.

Potemkin (V. I.). **The use of khlorofos for the control of flies on cattle farms.** [*In Russian.*]—*Veterinariya* **35** no. 6 pp. 51–52. Moscow, 1958.
Khatin (M. G.), Lur'e (M. Z.), Kolomiets (Ya. M.) & Solov'ev (V. P.). **The use of khlorofos for the control of** ***Hypoderma*** **attack on cattle.** [*In Russian.*]—*Op. cit.* **36** no. 2 pp. 82–85. 1959.
Potemkin (V. I.) & Gil'denblat (A. A.). **The use of khlorofos against** ***Hypoderma*** **infestation of cattle.** [*In Russian.*]—*T.c.* pp. 86–87.
Yanovich (G. I.). **A new means of controlling the warble-fly of cattle.** [*In Russian.*]—*T.c.* p. 87.

The first paper contains details of experiments in the Soviet Union in which aqueous sprays containing 0·25–2·5 per cent. trichlorphon (known there as khlorofos) gave good control of various flies, including *Musca domestica* L., in animal quarters within an hour and spray deposits of 0·5–1 g. toxicant per sq. metre remained effective against them for four days and 2 g. for 10–20 days. The other three papers record tests in which it was used in various ways against *Hypoderma* larvae in cattle. In the first of these, it is stated that good control was obtained when 1·5–2 per cent. aqueous solutions, preferably with a surface-active emulsifying agent, were rubbed into the back as the larvae were reaching the skin or when it was administered three times *per os* as a 10 per cent. aqueous solution at the rate of 75 or 100 mg. per kg. body weight while the larvae were migrating through the body. In the last two, subcutaneous treatment at 15–20 mg. per kg. in solutions of various concentrations is shown to have given conflicting results, whereas rubbing the skin of the back with 3–5 per cent. solutions proved effective.

PAPERS NOTICED BY TITLE ONLY.

Kane (P. F.), Cohen (C. J.), Betker (W. R.) & MacDougall (D.). **Assay of Co-Ral** [coumaphos] **in technical material and formulated products.** —*J. agric. Fd Chem.* **8** no. 1 pp. 26–29, 3 graphs, 10 refs. Easton, Pa., 1960.

Ch'in (Yao-ting). **Larvae of** ***Psychoda*** **urinated out from a male child patient in Shenyang.** [*In Chinese.*]—*Acta ent. sin.* **9** no. 1 pp. 96–98, 8 figs., 4 refs. [Peking] 1959. (With a summary in English.)

Blagoveshchenskiĭ (D. I.). **Lice (Siphunculata) of domestic mammals.** [*In Russian.*]—*Opred. Faune SSSR* no. 73, 10½ × 6¾ in., 87 pp., 99 figs., 4½ pp. refs. Moscow, Zool. Inst. Akad. Nauk SSSR, 1960. Price 5 *rub.* 80 *kop.*

CHRISTIE (M.). **Improved collection of Anopheline eggs and analysis of oviposition behaviour in** *A. gambiae*.—*J. trop. Med. Hyg.* **61** no. 11 pp. 282–286, 4 figs., 3 refs. London, 1958.

Several methods for collecting the eggs of Anophelines have been described in papers previously noticed [*R.A.E.*, B **29** 68; **31** 62; **39** 192], but none ensures a valid sample of the number of eggs laid. A method was developed in Tanganyika for the recovery in the field of a consistently high proportion of the eggs laid by *Anopheles gambiae* Giles in a prepared site simulating natural conditions. The oviposition pool consists of a metal box connected by means of a cistern and ballcock with a reservoir of egg-free water, and soil held in trays in the box gives the appearance of a natural bottom. The construction of the pool and the techniques by which the eggs are collected, freed from débris and sorted for identification are described. A test of the efficiency of the method, in which a known number of eggs was placed in the pool, indicated a recovery of about 60 per cent.

MARQUARDT (W. C.) & HAWKINS jr. (W. W.). **Experimental therapy of fly strike in sheep, using a systemic insecticide.**—*J. Amer. vet. med. Ass.* **132** no. 10 pp. 429–432, 9 refs. Chicago, Ill., 1958.

In Montana, in 1957, fenchlorphos (Trolene) was administered in bolus form to sheep with blowfly strike. Of 20 ewes and lambs infested in the breech area that were given 132–310 mg. insecticide per kg. body weight, 12 showed no larvae within 48 hours, three showed a few, and there was no effect on the infestation of two. In the remaining three, elimination of blowfly larvae either required longer than 48 hours or no observations were made until more than 48 hours after treatment. The most prompt and complete eradication occurred in sheep in which the larvae were feeding below the skin surface; superficial infestations were not controlled, or only partly controlled, and the drug appeared to be of no value when the skin had been blackened and mummified as a result of activity of the larvae. The dosages of fenchlorphos effective for control ranged from 150 to 200 mg. per kg. body weight, and in this range no toxic effects on the sheep were observed [*cf. R.A.E.*, B **46** 89]. One lamb given 310 mg. per kg. showed signs typical of poisoning by organic phosphorus compounds, but unlike those generally associated with fenchlorphos [*loc. cit.*]. The treatment seemed to give little or no protection against reinfestation.

DWORKIN (Z. Z.). **New attitudes toward insect repellency.**—*Soap & chem. Spec.* **35** no. 2 pp. 77, 79, 81, 83, 9 figs., 2 refs. New York, N.Y., 1959.

The author discusses the results of a study already noticed [*R.A.E.*, B **47** 133] of the effect on milk yield of reducing populations of stable flies [*Stomoxys calcitrans* (L.)] on dairy cows in the United States by means of repellents, and points out that, among the sprays giving good results, the only commercially priced one contained a mixture of 0·5 or 1 per cent. Tabutrex (di-n-butyl succinate) [*cf.* also **47** 9] and 0·05 per cent. pyrethrins. He then reviews other experiments showing that the repellency of Tabutrex is greatly enhanced by the addition of pyrethrins or allethrin, particularly after long exposure to ultraviolet light and high temperature (36°C. [96·8°F.]), two environmental conditions that occur on pastures. Other insecticides have a similar effect, which is quite independent of their toxicity.

Harris (R. L.). **Biology of the black-legged tick.**—*J. Kans. ent. Soc.* **32** no. 2 pp. 61–68, 5 refs. Manhattan, Kans., 1959.

The following is based largely on the author's summary. *Ixodes scapularis* Say is a common pest of hunting dogs in Arkansas and causes some loss to cattle in winter. The immature stages rarely attack domestic animals. Studies on the bionomics and seasonal occurrence of this tick were conducted at Fayetteville, Arkansas, from November 1956 to November 1957, with special attention to the effects of temperature and relative humidity, engorged females being collected from dogs. Adults were present from November to May, and the immature stages probably from early March to October. The optimum temperature for adults was about 70°F., and the mean maximum temperature at Fayetteville does not exceed 77·5°F. during the period when the adults are present. In the laboratory, the females oviposited and the eggs hatched in glass tubes, larvae were brushed on to the ears of a rabbit, where they attached and engorged, nymphs were fed on the ears and clipped belly of the rabbit, and adults engorged and paired in cages attached to its belly. The optimum temperature for the eggs was about 70°F., and that for the larvae and nymphs about 80°F. The favourable range of relative humidity was 90–100 per cent., and no survival occurred below 80 per cent. Under favourable conditions, the life-cycle lasted an average of 132 days, comprising 10 days for the preoviposition period, 48 days for the egg stage, 4 days for the larval feeding period, 23 days for the remainder of the larval stage, 5 days for the nymphal feeding period, 33 days for the rest of the nymphal stage and 9 days for the adult feeding period. In the field, there is probably only one generation a year, as considerable time is required for the unfed larvae, nymphs and adults to find hosts.

Williams (R. W.). **Ectoparasites of** *Rattus rattus* (**L.**) **in the Bermuda Islands, with a note on** *Ctenocephalides felis* (**Bouché**) (**Siphonaptera, Pulicidae**).—*Proc. ent. Soc. Wash.* **61** no. 1 pp. 33–35, 9 refs. Washington, D.C., 1959.

The following is substantially the author's summary. Of 27 rats (*Rattus rattus*) collected from five of the nine parishes of the Bermuda Islands, 21 were infested by one or more of the ectoparasites, *Hypoaspis* (*Androlaelaps*) sp., *Laelaps nuttali* Hirst, *L.* (*Echinolaelaps*) *echidninus* Berl., *Marquesania* (*Listrophoroides*) *expansa* (Ferris), *Xenopsylla cheopis* (Roths.) and *Polyplax spinulosa* (Burm.). These are reported from the area for the first time. The genus *Marquesania* has not apparently been reported previously from the New World, and *M. expansa* only from the Marquesas Islands [*R.A.E.*, B **21** 106]. *Ctenocephalides felis* (Bch.), also reported for the first time from the Bermudas, was very common on cats and dogs and was present in many human habitations. *Pulex irritans* L., previously reported, was also found in dwellings.

Sweatman (G. K.). **Biology of** *Otodectes cynotis*, **the ear canker mite of carnivores.**—*Canad. J. Zool.* **36** no. 6 pp. 849–862, 5 figs., 16 refs. Ottawa, 1958.

The following is based on the author's abstract and summary. All stages (egg, larva, protonymph, deutonymph and adults of both sexes) of *Otodectes cynotis* (Her.) are described, and an account is given of the life-cycle as determined in complete darkness at 35°C. [95°F.] and 80 per cent. relative humidity, under which conditions it lasts about three weeks. The sex of the immature stages cannot be determined, the adult males attaching themselves to deutonymphs of either sex. Mites from the dog, cat, fox and ferret are shown to be biologically and morphologically identical, and mites from different hosts interbred. The varietal names *canis* (Bendz), *cati* (Her.) (*felis* (Huber)) and *furonis* (Mégn.), therefore, fall in synonymy. Other carnivores also appear to be potential hosts.

Wolfe (L. S.) & Peterson (D. G.). **A new method to estimate levels of infestations of black-fly larvae (Diptera: Simuliidae).**—*Canad. J. Zool.* **36** no. 6 pp. 863–867, 3 figs., 7 refs. Ottawa, 1958.

The following is substantially the authors' abstract. A new method, developed in Canada, for estimating the level of infestation of Simuliid larvae in streams is described. Hollow, metal cones, 8 in. high, 4 in. in diameter at the base and painted white, were put in infested streams, and kept in position with a wire secured to the apex and fastened to an object in the stream or on the bank. The larvae attached themselves to the cones in preference to stones or vegetation. Counts of those attached gave estimates of the infestation in the stream, the periods when greatest numbers of larvae were moving downstream, and the fluctuations in number of larvae during the summer.

Sweatman (G. K.). **On the life history and validity of the species in *Psoroptes*, a genus of mange mites.**—*Canad. J. Zool.* **36** no. 6 pp. 905–929, 17 figs., 44 refs. Ottawa, 1958.

The egg, larva, protonymph, deutonymph and adult of *Psoroptes cuniculi* (Delafond), the ear mite of the rabbit, are described, but in the female the terms pubescent female and ovigerous female are used for the last two stages. Both the protonymph and deutonymph show sexual dimorphism. In pairing, the male and pubescent female have a long attachment period [*cf. R.A.E.*, B **47** 174]. From observations on collected eggs and mites, kept at 35°C. [95°F.] and 80 per cent. relative humidity in complete darkness, it is estimated that the egg and quiescent stages last about four days and 30 hours each, respectively, and that the complete cycle, including motile periods, would probably require three weeks.

Biological comparisons are made between the types of *Psoroptes* occurring in the ears of various hosts and also between the various kinds occurring on the body. The same mammal is shown to be on occasion the host of more than one species, and ear mites are sometimes found on the body, but there is no evidence that body mites can live in the ears. The mite occurring in the ears of goats (*P. caprae* Raill.) is shown to be morphologically and biologically identical in all stages with mites from the ears of rabbits. No differentiating morphological character is known for *P. hippotis* Raill. & Henry [**35** 80, 131], and *P. cuniculi* was shown to be able to establish itself in the ears of a donkey. *P. caprae* and *P. hippotis* are therefore considered synonyms of *P. cuniculi*. *P. cuniculi* could also establish itself in the ears of sheep. However, the fact that sheep scab has been virtually eradicated from New Zealand, Australia and Canada, while mites still occur commonly in the ears of rabbits and goats, indicates that *P. ovis* (Hering) is distinct from *P. cuniculi* but is a body rather than an ear mite. Records of this species in the ears of domestic sheep may need correction to *P. cuniculi*. *P. ovis* has been transferred from sheep to cattle and from cattle to sheep.

P. bovis (Gerl.) is accordingly treated as a synonym of *P. ovis*, which is considered a cosmopolitan body mite of sheep, cattle and horses. Two other species infesting the body of livestock are recognised, as they can be distinguished at least on a population basis if both morphological and biological criteria are used. They are *P. natalensis* Hirst, recorded on domestic cattle, zebu, Indian water buffalo and horse, and known from South Africa, Uruguay, Brazil, New Zealand and probably France, and *P. equi* (Hering), a body mite of the horse and probably other equines, arbitrarily restricted to specimens taken in England. Ear mites of the horse, like those of goat and sheep, are *P. cuniculi*, which is cosmopolitan and can also be a temporary body mite on horses. The only ear mite remaining distinct is *P. cervinus* Ward from bighorn (*Ovis canadensis*). A key for distinguishing the recognised species is given, and the phylogenetic relations of these species with each other and with the species in *Chorioptes*, *Caparinia* and *Otodectes* is discussed, and two new subfamilies are erected for two distinct lines of development, Psoroptinae comprising the genus *Psoroptes* and Chorioptinae the other three.

Wolfe (L. S.) & Peterson (D. G.). **Black flies (Diptera: Simuliidae) of the forests of Quebec.**—*Canad. J. Zool.* **37** no. 2 pp. 137–159, 1 pl., 5 figs., 44 refs. Ottawa, 1959.

The following is based largely on the authors' abstract. In 1954 and 1955, 22 species of Simuliids, three of them new to science, were found in the Baie Comeau area of Quebec. *Simulium venustum* Say constituted 75–80 per cent. of the population and was the major species biting man. *Prosimulium hirtipes* (Fries), *S. parnassum* Mall. and *S. tuberosum* (Lndst.) were also pest species. *S. verecundum* Stone & Jamnback was identified in collections made in August 1955. Accounts are given of feeding and other habits of the adults, and of dispersal, transportation, stream-current preferences and predators of the larvae. The structure of the unique pupal cocoon of *Cnephia invenusta* (Wlk.), and the formation of its stalk from the stems of dead moss, were studied.

Heimpel (A. M.) & West (A. S.). **Notes on the pathogenicity of** *Serratia marcescens* **Bizio for the cockroach** *Blattella germanica* **L.**—*Canad. J. Zool.* **37** no. 2 pp. 169–172, 6 refs. Ottawa, 1959.

The following is substantially the authors' abstract. The gram-negative bacterium, *Serratia marcescens* [*cf. R.A.E.*, A **48** 359, 412] sporadically caused mortality in cultures of *Blattella germanica* L. Extensive feeding tests showed that it is not normally pathogenic for the cockroach by mouth. The LD50 by injection was about 38,000 bacteria per insect.

Bowman (M. C.), Acree jr. (F.), Schmidt (C. H.) & Beroza (M.). **Fate of DDT in larvicide suspensions.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1038–1042, 1 graph, 10 refs. Menasha, Wis., 1960.

The following is based largely on the authors' abstract. The toxicity to mosquito larvae of DDT in suspensions from acetone solutions is affected by the volume of suspension and the type of test container [*cf. R.A.E.*, B **49** 8, etc.]. To learn whether the differences are due to settling, the settling rates and dispersion of DDT in suspensions of different concentrations were determined by the use of DDT labelled with ^{14}C. Settling took place at a concentration of 1 part per million but hardly at all at 0·01 p.p.m., a concentration approximating that normally used in larvicide tests. In further studies of suspensions at 0·01 p.p.m., a high proportion of the DDT was found deposited on the inner walls of glass [*cf.* **37** 82], aluminium or paper containers when sampling took place two minutes after preparation, and the concentration of DDT in the liquid was thereby reduced. More than 50 per cent. of the DDT was lost by volatilisation with the liquid phase during 24 hours. This volatilisation and the deposition on the walls of the container appear to account for the loss of DDT from test suspensions. A physicochemical explanation for the findings is presented. Although at 0·01 p.p.m., the DDT might be considered as being in solution, the term ' suspension ' is retained because of the unequal distribution of the DDT found. In such extremely low concentrations, it is natural to expect a large proportion of a non-polar solute to be situated at the interfaces, or the DDT may be regarded as so hydrophobic that it tends to migrate from the body of the liquid, where it is surrounded on all sides by water, to the interface, where it is partly in contact with water and partly with air, glass or some other substance. These factors, rather than settling, render much of the DDT unavailable to mosquito larvae.

EDMUNDS (L. R.) & BLAKESLEE (T. E.). **Intensive limited area control of potential arthropod disease vectors.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1050–1053, 1 graph. Menasha, Wis., 1960.

The following is based largely on the authors' abstract. In July 1958, the intensive control of insects and mites in limited areas was studied in the field in Virginia, to test the insecticide-dispersal equipment available to the army and to obtain information useful for the control of arthropod vectors of disease under emergency conditions. Before treatment, samples were taken of the natural populations of mites, mosquitos and other insects in a 20-acre control and in a 40-acre treatment area, similar in physical characteristics. In addition, 100,000–200,000 laboratory-reared larvae and pupae of *Musca domestica* L. were released in the treatment area on 14th July. Insecticides were applied daily for ten days beginning on 15th July, DDT as a 10 per cent. spray, fog or dust, or 2·7 per cent. malathion as a fog; the total amount of insecticide applied per acre was 17·7 lb. DDT and 1·04 lb. malathion. The first application (DDT spray) caused a sharp reduction within 24 hours in all natural insect and mite populations, which were reduced to very low levels and held there until treatment stopped; no similar reduction occurred in the control area. The numbers of the introduced house-flies were considered to be reduced more slowly; they reached their peak on the day after the first application and dropped on the following day, but persisted until 22nd July. After treatment ceased, the numbers of mosquitos collected in the treated area rose sharply within 48 hours, but those of the other insects and the mites did not increase throughout the following week.

KRUEGER (H. R.) & O'BRIEN (R. D.). **Relationship between metabolism and differential toxicity of malathion in insects and mice.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1063–1067, 6 figs., 12 refs. Menasha, Wis., 1960.

The following is virtually the authors' abstract. An attempt was made to account for the selective toxicity of malathion on the basis of differences in its metabolism by various species. Eleven metabolites were found in *Blattella germanica* (L.), *Periplaneta americana* (L.) and *Musca domestica*

L., and seven in mice. Most of the metabolites were identified. Degradation of malathion is much more extensive in mice than in insects, and malaoxon production is correspondingly lower; these effects account satisfactorily for the low toxicity of malathion to mice. The low toxicity of topically applied malathion to *B. germanica* is attributable to poor penetration through the integument.

Sternburg (J.), Chang (Shen-chin) & Kearns (C. W.). **The release of a neuroactive agent by the American cockroach after exposure to DDT or electrical stimulation.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1070–1076, 1 fig., 17 refs. Menasha, Wis., 1960.

The following is virtually the authors' abstract. A toxicant acting on the nervous system is released into the blood of *Periplaneta americana* (L.) during the course of DDT poisoning. The active principle is soluble in water, methanol and ethanol, but insoluble in non-polar solvents. Biological activity of the toxicant is destroyed by acetone and alkaline conditions. Although the chemical structure of the toxicant is unknown, it is chemically, chromatographically and biologically distinct from acetylcholine, epinephrine, norepinephrine, histamine, γ-aminobutyric acid and 5-hydroxytryptamine. A substance with the same biological, chromatographic and chemical properties as the DDT-induced agent can be produced in cockroaches by repeated mild electrical shocks. Electrical stimulation of isolated thoracic and abdominal nerve cords also results in the release of the substance into the perfusing saline, as does topical application of DDT to intact cerci connected by the cercal nerves with the isolated central nerve cord. The source of the toxicant is apparently the central nervous system itself during periods of great nervous activity, whether initiated by electrical stimulation or by the constant bombardment of the sensory-central synapses by excessive afferent impulses generated in the sensory nerves by the direct action of DDT.

Sokal (R. R.) & Hiroyoshi (T.). **The supposed correlation between the ratio X_5 and DDT-resistance in house flies.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1077–1080, 9 refs. Menasha, Wis., 1960.

The following is substantially the authors' abstract. The ratio X_5, defined by Bigelow & LeRoux [*R.A.E.*, B **43** 164], was measured on both sexes of eight strains of *Musca domestica* L. differing in their susceptibility to DDT. Resistance levels were determined by probit analysis of the results of topical application of the insecticide. Significant differences were found among strains and among flies of the same strain from different rearing jars, as in an earlier study. Significant differences between resistant and non-resistant strains were found for X_5, but the difference was the opposite of that reported by Bigelow & LeRoux [*loc. cit.*] and by Morrison [**46** 167]. Further analyses led to the conclusion that the morphological difference between resistant and non-resistant strains found in the present study is a function of the particular strains used and that no correlation between resistance and X_5 can be demonstrated.

Blázquez (J.). **The residual insecticidal effect of Bayer Compound S–1752 (Bayer 29 493) in laboratory tests.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1096–1099. Menasha, Wis., 1960.

Laboratory tests were carried out in Venezuela on the effectiveness of deposits of O,O-dimethyl O-3-methyl-4-methylthiophenyl phosphorothioate, termed Bayer S-1752 or Bayer 29493 and here defined as O,O-dimethyl O-(4-methylthio-m-tolyl)phosphorothioate. Insects confined under petri dishes were exposed for various periods to glass plates and to adobe (sun-dried mud) or encalado (sun-dried mud covered with a thick layer of lime and water after drying) contained in wooden frames, all of which surfaces had been sprayed with a 20 per cent. wettable powder at rates of 1 or 3 g. active ingredient per sq. m. A normal strain and a DDT-resistant strain of *Musca domestica* L. were exposed to the treated surfaces as adults, 3–8 days old, in groups of 20–30. Both strains were exposed for contact periods of 5, 15 or 30 minutes, and mortality was observed after 24 hours. In addition, the normal strain was exposed to the insecticide continuously, and knockdown was observed periodically. Fifth-instar nymphs of *Rhodnius prolixus* Stål were exposed to the insecticide, 2–4 days after their last blood-meal, in groups of 10–20, for 10, 30 or 60 minutes with daily records of knockdown for 10 days. Females of *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) were exposed in groups of 15–20, 5–15 hours after being fed, for 5, 15 or 60 minutes, and mortality was recorded after 24 hours. High mortality of susceptible and resistant flies was obtained on all surfaces in the first few weeks and was maintained for 14 weeks in tests with glass plates, but the kill decreased irregularly in tests with adobe and encalado at both rates of application. Similar results were obtained in the continuous exposure tests with *M. domestica*, rapid knockdown continuing for up to 76 days on glass plates, but more than 7 hours were needed for 50 per cent. knockdown on adobe or encalado 65 days after their treatment. The tests with *Rhodnius* and *Culex* showed persistence of effectiveness on glass and erratic results with the other two materials.

Fukuto (T. R.), Metcalf (R. L.) & Winton (M.). **Alkylphosphonic acid esters as insecticides.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1121–1127, 1 graph, 19 refs. Menasha, Wis., 1960.

Since little was known of the insecticidal properties of alkyl phosphonates other than EPN and trichlorphon (Dipterex), a series of these compounds was tested for toxicity to several insects.

LD50's for *Musca domestica* L. were determined topically and correlated with inhibition of fly-brain cholinesterase and hydrolysis rates. Among the ethyl p-nitrophenyl alkylphosphonates, toxicity decreased slightly in straight-chain compounds as the alkyl portion was varied from methyl to butyl, all being at least as toxic as paraoxon (LD50 1·2 µg. per g.), decreased abruptly for the amyl and hexyl compounds, and was increased by unsaturation, the alkyl compound being nearly twice as toxic as the n-propyl. The phenyl compound was also very toxic and much more so than the cyclohexyl. The results for branched-chain compounds were more complex, toxicity being reduced considerably in some. Toxicity in all these compounds varied consistently with the reactivity of the molecule, measured in terms of hydrolysis constants, bimolecular rate constants for the reaction with fly-brain cholinesterase and the polar substituent constants.

Among alkyl p-nitrophenyl ethylphosphonates, the effects were less marked; toxicity decreased only slightly when the alkyl chain was extended from methyl to butyl and was still relatively high at C_6 and C_8. O-Ethyl O-p-nitrophenyl ethylphosphonothioate, the most toxic of all the compounds, and EPN were slightly more and O-ethyl O-p-nitrophenyl butylphosphonothioate less toxic than their oxygen analogues, although they were all more stable to hydrolysis and had lower rates of cholinesterase inhibition, and it is presumed that conversion of double-bonded sulphur to double-bonded oxygen occurs in animals during the poisoning process. The S-ethyl, S-n-propyl and S-isopropyl p-nitrophenyl ethylphosphonothioates were only one-sixth as toxic as their oxygen analogues, although very effective inhibitors of cholinesterase, and this was probably due to their relatively high susceptibility to hydrolysis. Ethyl S-p-nitrophenyl ethylphosphonothioate, in spite of slightly higher anticholinesterase activity, was, unexpectedly, even less toxic than the S-ethyl isomer.

A strain of *M. domestica* that was very resistant to DDT- and cyclodiene-type chlorinated hydrocarbons was almost completely susceptible and one that was resistant to Chlorthion and malathion only slightly resistant to both O-ethyl O-p-nitrophenyl ethylphosphonothioate and EPN.

When tested topically against *Periplaneta americana* (L.), ethyl p-nitrophenyl propylphosphonate was slightly more toxic than paraoxon, O-ethyl O-p-nitrophenyl ethylphosphonothioate and parathion, which decreased in that order, and the ethylphosphonothioate was equal or superior to parathion against *M. domestica*. In solution in water containing fourth-instar larvae of *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.), the propylphosphonate and paraoxon were about equally toxic and less so than the ethylphosphonothioate and parathion, which were comparable in effect.

GOUCK (H. K.) & BOWMAN (M. C.). **Effect of repellents on the evolution of carbon dioxide and moisture from human arms.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1157–1159, 12 refs. Menasha, Wis., 1960.

The following is substantially the authors' abstract. Dimethyl phthalate, N,N-diethyl-m-toluamide and ethyl hexanediol, applied to the arms of three subjects, did not affect the output of moisture through the skin, but all three reduced that of carbon dioxide from two of the subjects, and N,N-diethyl-m-toluamide reduced it from the third. Production of carbon dioxide was correlated directly, and production of moisture inversely, with natural attractiveness in the absence of the repellents, but natural attractiveness was not correlated with the protection obtained with them.

GERSDORFF (W. A.) & PIQUETT (P. G.). **Relative toxicity, knockdown effectiveness, and intensity of synergism of mixtures of piperonyl butoxide with barthrin and some of its isomers.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1168–1171, 6 refs. Menasha, Wis., 1960.

The following is mainly the authors' abstract. When applied to *Musca domestica* L. in a synergist:insecticide ratio of 10:1 as space sprays on the Campbell turntable [*cf. R.A.E*, B **26** 246], mixtures of piperonyl butoxide with barthrin (6-chloro-piperonyl *dl-cis-trans*-chrysanthemate) and its *d-trans*-, *dl-trans*- and *dl-cis*-isomers [*cf.* **48** 175] were, respectively, 1·06, 1·72, 1·12 and 0·843 times as toxic and 0·166, 0·246, 0·172 and 0·141 times as effective in knockdown as allethrin alone. Synergism with respect to both lethality and knockdown was demonstrated in all mixtures, the intensity ratios being about 3. The range for relative toxicity between 5 and 95 per cent. mortality levels was from 69 to 146 per cent. of the toxicity at the 50 per cent. level, and the range for intensity of synergism was 94 to 107 per cent. of the intensity at that level.

KRAEMER (P.). **Relative efficacy of several materials for control of poultry ectoparasites.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1195–1199, 2 refs. Menasha, Wis., 1960.

Following laboratory tests, field tests were carried out in California on the comparative efficacy of nine chemicals for the control of *Argas persicus*

(Oken), *Menacanthus* (*Eomenacanthus*) *stramineus* (Nitzsch) and *Ornithonyssus sylviarum* (C. & F.) on hens, and the following is substantially the author's abstract of the results. *A. persicus* was effectively controlled by Sevin when premises were sprayed with a 1 per cent. emulsion spray and a similar 0·5 per cent. spray was applied to the hens at the rate of 1 U.S. gal. per 112 birds, and promising though inconclusive results were obtained with sprays of Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate) and fenchlorphos (Korlan), but a 1 per cent. spray of trichlorphon (Dylox) applied to premises and birds proved unsatisfactory. *M. stramineus* was effectively controlled by a 0·5 per cent. spray of trichlorphon solution at 1 U.S. gal. per 85 birds, a 0·1 per cent. fenchlorphos emulsion spray at 1 U.S. gal. per 106 birds used in conjunction with spraying of the nests and litter, a 0·5 per cent. Sevin emulsion spray at 1 U.S. gal per 112 birds or a 0·5 per cent. Sevin dust used at 3·9 oz. per 100 birds. Promising but inconclusive results were given by a 0·25 per cent. fenchlorphos suspension spray. *O. sylviarum* was effectively controlled by spraying at the rate of 1 U.S. gal. per 96–98 birds with a 0·1 per cent. suspension of coumaphos (Co-Ral), 0·25 per cent. emulsions of Dibrom, fenchlorphos or Sevin, or a 0·5 per cent. suspension of Sevin. A 5 per cent. Sevin dust applied by puff duster at the rate of 4 oz. per 100 birds was also effective. Unsatisfactory results were given by suspension sprays of Tedion or Dowco 109 [O-methyl O-(4-tert.-butyl-2-chlorophenyl) methylphosphoramidothioate], dusts of Delphene (N,N-diethyl-m-toluamide), Dibrom, Tedion or Santocel (a silica aerogel).

Baumhover (A. H.), Husman (C. N.), Skipper (C. C.) & New (W. D.). **Field observations on the effects of releasing sterile screw-worms in Florida.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1202–1206, 1 map, 6 refs. Menasha, Wis., 1960.

Callitroga hominivorax (Coq.) was eradicated from Curaçao in 1954 by the release of sterile males [*cf. R.A.E.*, B **44** 103, etc.]. The method was tested in Florida, and the following is based mainly on the authors' abstract of this account of the work. About two million sterile flies were released weekly over an area of 2,000 sq. miles in 1957, giving a rate of some 500 males per sq. mile. The insects had been irradiated as pupae, within two days of the emergence of the adults, with γ-radiation from activated cobalt (^{60}Co) in doses of 6,200–8,300 r. They were packed at the rate of 880 (later 550) pupae per release carton, and distributed daily, except on Sundays, in May–August in 1-mile swaths, six miles apart, from a small aeroplane. By moving the flight lanes each day the area was covered weekly. Collections of egg-masses in the treated area from goats in pens [*cf.* **44** 104] decreased from a weekly average of 41 per pen during the first two months to 11 in the 12th week. Collections outside the release area indicated a continuing high population north of the treated area, but a decline to the west and south. At the end of three months, 70 per cent. of the egg-masses collected in the release area were sterile.

Roberts (R. H.). **Field tests with five insecticides for the control of horn flies.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1216–1217, 3 refs. Menasha, Wis., 1960.

In tests in Texas in the summer of 1958, sprays containing Sevin or coumaphos (Co-Ral) in wettable powders, dicapthon in an emulsion concentrate, or Delnav [2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)] or fenchlorphos (ronnel) in both were tested for the control of *Siphona irritans* (L.) on cattle, and their effectiveness was compared with that of the recommended insecticide, methoxy-DDT (methoxychlor) in a wettable powder. The insecticides, which were applied to run-off on each animal, were considered to have failed when the average number of adults per animal exceeded 25. Methoxy-DDT, at 0·5 per cent., prevented reinfestation for about 21 days [*cf. R.A.E.*, B **38** 84; **39** 121; **43** 24]. Dicapthon and Sevin, at 0·5 per cent., failed within the first week. Delnav, at 0·15 per cent., prevented reinfestation for periods ranging from 11 days when the reinfestation pressure was high to 49 days when it was low, and fenchlorphos for about 30 days in a wettable powder, at 1 or 0·5 per cent., and about 12 days in an emulsion concentrate, at 0·5 per cent. Protection with coumaphos, at 0·5 per cent., ranged from 14 to 40 days, with an average of 24 days.

GRAHAM (O. H.) & others. **A comparison of ronnel and Co-Ral sprays for screw-worm control.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1217–1218, 1 ref. Menasha, Wis., 1960.

Field tests on cattle, preceded by preliminary tests on artificially infested sheep, were carried out in south-western Texas in 1958 to compare sprays of fenchlorphos (ronnel) and coumaphos (Co-Ral) for the control of *Callitroga hominivorax* (Coq.). On one ranch, in April, 0·5 per cent. coumaphos and 1 per cent. fenchlorphos gave equally effective protection; on another, in June, the former gave better protection than the latter, and on a third ranch, in November, the first gave only slightly better results than an equal concentration of fenchlorphos. In two tests, some cattle were treated with Smear No. 62 or EQ-335 [*cf. R.A.E.*, B **47** 139], but neither was as effective as the sprays.

DRUMMOND (R. O.), MOORE (B.) & WARREN (J.). **Tests with insecticides for control of the winter tick.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1220–1221, 1 ref. Menasha, Wis., 1960.

Tests were conducted near Kerrville, Texas, in the winters of 1957–58 and 1958–59, to determine the initial kill and residual effectiveness of new spray materials for the control of *Dermacentor albipictus* (Pack.) on cattle. The toxicants used and (in brackets) the percentage concentrations were Delnav [2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)] (0·15), malathion (0·1–0·5) (in 1957–58 only) and, as the standard of comparison, toxaphene (0·5) in emulsion concentrates, fenchlorphos (ronnel) and coumaphos (Co-Ral) (0·25 in 1957–58 only and 0·5) and Sevin (0·1–0·25 in 1957–58 and 0·5 in 1958–59) in wettable powders and Bayer 22408 (O,O-diethyl O-naphthalimidophosphorothioate) in an emulsion concentrate (0·25) in 1957–58 and in a wettable powder (0·5) in 1958–59. Counts of the ticks on five animals were made at various intervals. In 1957–58, all treatments reduced the numbers of adult ticks in one day. Delnav, fenchlorphos, malathion at 0·5 per cent., coumaphos, Bayer 22408 and toxaphene afforded almost 100 per cent. control after one week, and the numbers remained low for three weeks. Sevin was not as effective as toxaphene, and malathion at 0·1 and 0·25 per cent. failed to prevent reinfestation by newly-emerged adults. In one of the two herds treated in 1958–59, all materials gave equal control for three months. In the second herd, all treatments reduced populations for a month, toxaphene being the least effective. Two months after treatment, tick numbers increased, and Delnav and Sevin were more and fenchlorphos less effective than toxaphene.

Drummond (R. O.). **Cattle grubs in gullets of cattle from southwestern Texas.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1221–1222, 4 refs. Menasha, Wis., 1960.

As information on the seasonal incidence of *Hypoderma* larvae in the gullets of cattle [*cf. R.A.E.*, B **46** 50, etc.] aids in determining the time for treatment with systemic insecticides [*cf.* **47** 16; **48** 17, 164], the gullets of cattle from south-western Texas were collected regularly in 1957–59, and examined for larvae of *H. lineatum* (Vill.). From May to October, more than half the gullets were infested, with the largest percentages in July–September. The largest numbers of larvae were found in August and September. After October, infestation and numbers of larvae declined rapidly until none was found in January. In 1958, the first larva was found during the first week of March, and in 1959, more than a month later. Peaks of infestation and of numbers of larvae in the gullets were later in 1958–59 than 1957–58, as were the first appearance and peak populations of larvae in the backs of the cattle.

Kohler (P. H.), Rogoff (W. M.) & Duxbury (R.). **Continuous individual feeding of systemic insecticides for cattle grub control.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1222–1223, 8 refs. Menasha, Wis., 1960.

Hypoderma larvae in cattle have been controlled by the administration of fenchlorphos (ronnel) in a mineral mixture [*cf. R.A.E.*, B **49** 7], and further work was carried out in South Dakota in 1955–56 and 1956–57 to test the value of administering various chemicals in a grain ration, fed dry to calves, for the control of *H. bovis* (Deg.) and *H. lineatum* (Vill.). In 1955–56, nicarbazin (a complex of 4,4′-dinitrocarbanilide and 2-hydroxy-4,6-dimethylpyrimidine), S.D. 75 (2-(p-nitrobenzamido)-5-nitrothiozole) or S.D. 51 (9-amino-acridine HCl) were incorporated in the grain rations of calves to give dosages of 5 mg./kg. body weight, based on the initial weights of the animals. Treatment began about a month before the normal time for the appearance of *Hypoderma* larvae, as soon as practicable after weaning, and calves were fed individually for 84 consecutive days. The grain ration of each included 1 lb. of medicated feed each day. Monthly larval extractions were made after the appearance of larvae in the backs of the calves. In 1956–57, fenchlorphos was administered at 30 mg./kg. for seven consecutive days and at 15 mg./kg. for 79 days, and nicarbazin was fed at five times the dosage used the previous year and for a longer period. In the 1955–56 tests, the calves in all treatments were heavily infested with larvae, although slightly less so than the untreated animals, and nicarbazin was a little more effective than any of the others. In 1956–57, nicarbazin reduced larval numbers only slightly more than in the earlier tests, but fenchlorphos provided outstanding reductions, and no toxic symptoms were observed in any of the calves.

Kohler (P. H.) & Rogoff (W. M.). **Studies with phenothiazine and Hypolin for the control of cattle grubs.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1223–1224, 9 refs. Menasha, Wis., 1960.

As the administration of phenothiazine or Hypolin (a proprietary mixture of phenothiazine, di-n-butyl tin dilaurate and hexachlorethane) to cattle had no effect on *Hypoderma* larvae in previous tests in South Dakota, further tests were carried out in 1955. At one station, 20 calves were given a drench four times at monthly intervals from 15th November, affording 1½ oz. phenothiazine per animal, and at a second station, animals were treated similarly with Hypolin. At the third station, phenothiazine was mixed 1:9 with trace-mineralised salt and no other source of mineral supplement was available. The calves consumed an average of 1·35 g. phenothiazine daily for 144 days from 22nd November. Periodic gains in weight were recorded and monthly counts of larvae were made. No control was given by the drenches and little, if any, by the salt treatment.

de Ong (E. R.). **Chemical and natural control of pests.**—9¼ × 6 in., viii + 244 pp., 12 figs., many refs. New York, N.Y., Reinhold Publ. Corp.; London, Chapman & Hall, Ltd., 1960. Price £3.

This book, which is reviewed more fully elsewhere [*R.A.E.*, A **49** 61] was written to assist in the evaluation of biological factors and chemical treatment in the control of injurious arthropods and other pests, with special reference to conditions in the United States. Of the two main parts into which it is divided, the first is concerned with natural control and the second largely with chemical methods; the latter includes chapters on the control of insects, mites and ticks attacking poultry and domestic animals and on household insects and rodents.

Report of the Seventh Commonwealth Entomological Conference 6th–15th July 1960.—iii + 399 pp., 18 figs., refs. London, Commonw. Inst. Ent., 1960. Price £2 10*s*.

This report, which is noticed as a whole elsewhere [*R.A.E.*, A **49** 52], includes five appendices. One of them contains the text of the papers read at the scientific (open) meetings and reports of the discussions on them, and another comprises a series of reviews of work on economic entomology in Commonwealth territories during 1954–59. The papers read [*cf. loc. cit.*] included: Recent advances in tsetse [*Glossina*] and trypanosomiasis research and reclamation, pp. 125–128, by J. Ford, and The control of tsetse flies with insecticides, pp. 128–131, 13 refs., by K. S. Hocking. Most of the reviews of work on economic entomology are concerned with agriculture, but some of them [*cf. loc. cit.*] include information on *Glossina* spp. in Tanganyika, Uganda, Kenya, Nyasaland, Northern and Southern Rhodesia and Nigeria, mosquitos with special reference to *Wuchereria malayi* in Malaya, Anophelines and malaria in Aden and Nigeria, sheep blowflies in South Africa, Ixodid ticks in East Africa and Australia, and various pests of veterinary importance in Canada.

Shura-Bura (B. L.) & others. **On the nature of the dispersion from the point of release of some species of flies of medical importance.** [*In Russian.*]—*Rev. Ent. URSS* **37** pt. 2 pp. 336–346, 3 figs., 8 refs. Moscow, 1958. (With a summary in English.)

The following is substantially the authors' summary. In 1955, 87,000 flies, largely *Musca domestica* L. and *Phormia* (*Protophormia*) *terraenovae* R.-D. were labelled with radioactive sodium phosphate administered in their food and released on 8th July, when there was a light northerly wind, in a sparsely populated area about nine miles to the south of Leningrad. Catches of radioactive flies (281) during the next 2–12 days at points towards and away from the city indicated that the prevailing route of migration was towards Leningrad, though a large proportion of the flies remained in inhabited places on the way. The greatest distances were covered by *Musca stabulans* (Fall.), which was recaptured on the outskirts of Leningrad, and *Musca domestica* and *P. terraenovae*, which were recovered about six miles from the point of release.

Déduit (Y.). **Études sur la ponte par autogénèse des culicides. III. Données numériques sur l'acte de ponte chez la femelle fécondée de** *Culex pipiens autogenicus* **Roubaud (plusieurs femelles avec un mâle).**—*C. R. Soc. Biol.* **151** (1957) no. 11 pp. 1954–1956, 2 refs. Paris, 1958.

In the experiments recorded in this third part of a series [*cf. R.A.E.*, B **47** 129], in which groups of four females of *Culex pipiens molestus* Forsk. (*autogenicus* Roub.) were kept, each with one male, the proportions of females that developed eggs and the numbers of eggs formed increased with wing length in the same way as in isolated (unmated) females, but the number of rafts laid also increased with wing length and almost all females that oviposited laid all their eggs. There was thus no group effect, the results being the same as those obtained when each female was confined with one male [*cf. loc. cit.*].

Grégoire (C.), Cotteleer (C.) & Pouplard (L.). **Étude du pouvoir acaricide du lindane, du DMC et du DDT. Synergisme et antagonisme.**—*C. R. Soc. Biol.* **152** no. 6 pp. 1022–1025, 3 graphs, 3 refs. Paris, 1958.

In *in vitro* tests of the effectiveness of γ BHC (lindane), DMC, DDT and combinations of them on *Psoroptes cuniculi* (Delafond) from the ears of rabbits, the mites were sprayed in petri dishes with fresh emulsions made by dissolving the insecticide in 5 parts medicinal paraffin and adding 1 part emulsifier and distilled water to make 100 parts. All mites were killed in 60 minutes by γ BHC at 0·1 per cent. Higher concentrations showed no advantage. DMC was much slower in action; the optimum concentration was 0·5 per cent., but even this did not give complete control in two hours. The addition of a small amount (0·1 per cent.) of DDT, which is itself only very weakly active against *P. cuniculi* [*cf. R.A.E.*, B **45** 60], greatly enhanced the effectiveness of 0·1 or 0·5 per cent. DMC [*cf.* **43** 28]. However, tests of mixtures of 0·1 per cent. γ BHC and 0·5 per cent. DMC or 0·05 per cent. γ BHC and 0·7 per cent. DMC revealed a strong antagonism between the two compounds.

Martin (L.) & Cotteleer (C.). **Étude quantitative de la courbe de mortalité d'acares saines à l'action du gammexane et du DMC.**—*C. R. Soc. Biol.* **152** no. 6 pp. 1026–1028, 2 graphs, 3 refs. Paris, 1958.

A quantitative analysis of the rate of mortality among mites [*Psoroptes cuniculi* (Delafond)] that had been exposed to γ BHC (lindane) or DMC [see preceding abstract] showed that there was an initial phase (lasting 30–60 minutes according to the strength of the toxicant used), in which the relation between the corrected rate of mortality and time that elapsed between exposure and death corresponded to a parabolic curve, followed by one in which there was a straight-line relation that gave way, in turn, to another curve similar to the first after about 120 minutes. The hypothesis of a cumulative action of the toxicant explains the observations.

McMillan (H. L.). **Study of a naturally occurring population intermediate between** *Culex p. pipiens* **and** *C. p. quinquefasciatus.*—*Amer. J. trop. Med. Hyg.* **7** no. 5 pp. 505–511, 6 graphs, 4 refs. Baltimore, Md., 1958.

In the United States, *Culex pipiens pipiens* L. occurs in temperate regions, but is replaced by *C. p. fatigans* Wied. (*quinquefasciatus*, auct.) in warmer regions, and forms morphologically intermediate between the two occur in areas where they intermingle [*R.A.E.*, B **47** 93]. Observations were made, during 1955–57, on the morphological changes in an anautogenous population that occurred naturally in Lawrence, Kansas, and was composed mainly of *C. p. pipiens*, with many intermediates and a few of *C. p. fatigans*. Comparisons were made with *C. p. fatigans* from Alabama, with the typical form from Minnesota and New Jersey, and with an autogenous strain (' *molestus* ') from California, composed mainly of intermediates, and believed to be the first report of an autogenous strain of *C. p. pipiens* that is not morphologically similar to the typical form.

The following is based on the author's summary and discussion of the observations. The characters used for study were the DV/D ratio of the males [**40** 187] and the siphonal tufts and other characters of the larvae. Typical *C. p. pipiens* males have DV/D ratios less than 0·2 and *C. p. fatigans* more than 0·4 (usually more than 0·5). The DV/D ratios increased in a few generations in two colonies established from the Lawrence population in late 1955 and 1956, and this effect was thought to be produced by selection in the laboratory that favoured *C. p. fatigans*. The mean DV/D ratio in the males reared from immature stages collected from one breeding place increased throughout the breeding season, and from samples reared from individual egg-rafts it could be seen that this increase was largely due to the production of individuals with higher ratios later in the season. This probably indicates an influx of individuals more like *C. p. fatigans* from other areas, presumably from the south. Analyses of the variation in the branching of the siphonal tufts of larvae showed the same trend as was seen in the DV/D ratio. The results confirm that *C. p. pipiens* and *C. p. fatigans* are biological entities, which intergrade in the field and are therefore of subspecific status.

Bonnet (D. D.) & Chapman (H.). **The larval habitats of** *Aedes polynesiensis* **Marks in Tahiti and methods of control.**—*Amer. J. trop. Med. Hyg.* **7** no. 5 pp. 512–518, 22 refs. Baltimore, Md., 1958.

Aëdes polynesiensis Marks (*pseudoscutellaris*, auct.) is a vector of *Wuchereria bancrofti*, and its breeding places and control in Tahiti are reviewed [*cf. R.A.E.*, B **42** 150; **43** 202; **46** 21, etc.]. The most important sources of *A. polynesiensis* in Tahiti are the permanent natural breeding sites, which include tree holes, rock holes and crab holes; these maintain the population through dry periods and from them the temporary sites, in which mosquitos are not produced during such periods, are reinfested. The elimination of all containers in which mosquitos can breed would be the best method of control, but is not always practicable, and a concentrated attack on the permanent natural sites should produce a greater reduction for the effort expended and so be less costly. The control of tree-hole breeding has already been discussed [**46** 199, etc.]. Although there is no practical method of eliminating mosquito breeding in rock holes in the mountainous areas, the application of concrete to the holes in such rocks as cannot be overturned will eliminate these on the coast, where most of the human population resides. Control of breeding in holes dug by the land crab, *Cardisoma carnifex*, is best effected by elimination of the crab itself and this has been obtained by placing a little carbon bisulphide in each hole and closing it with soil; a less expensive method, the introduction of bread impregnated with 0·03 per cent. parathion suspension into each hole, proved successful in preliminary trials. Control of temporary breeding sites is also discussed.

Mohr (C. O.). **Relation of mean number of fleas to prevalence of infestation on rats.**—*Amer. J. trop. Med. Hyg.* **7** no. 5 pp. 519–522, 8 graphs, 3 refs. Baltimore, Md., 1958.

The following is mainly the author's summary. A comparison was made of the relation between the mean number per infested rat (*Rattus rattus* and *R. norvegicus*) of *Xenopsylla cheopis* (Roths.), which is the vector of murine typhus in rats and man, and the prevalence of infestation in four climatic zones in the south-eastern United States. In spring, an increase of the mean number of fleas per infested rat, probably accompanied by increased activity of both rats and fleas, induces an increased prevalence of infestation. A decrease of the mean number of fleas per infested rat, presumably most pronounced in habitats least favourable for fleas, later induces a decline in prevalence. Two periods of increase and decrease occur in North Carolina and Tennessee, the northernmost zone, and New Orleans and south Texas, the southernmost zone, and only one each in the central zones. The second annual peak in the northernmost zone seems to be induced by the movement of rats into artificially heated buildings in autumn. These fluctuations are related to reported peaks and low points of prevalence of murine typhus in man.

Rozeboom (L. E.). **Hybridization of** *Culex pipiens fatigans* **Wiedemann from the Philippine Islands with American strains of the** *Culex pipiens* **group (Diptera: Culicidae).**—*Amer. J. trop. Med. Hyg.* **7** no. 5 pp. 526–530, 9 refs. Baltimore, Md., 1958.

The following is substantially the author's summary and conclusions. Hybridisation experiments with *Culex pipiens fatigans* Wied. from Luzon in the Philippine Islands, and strains of *C. p. fatigans* from Texas, *C. p. pipiens* L. and *C. p. molestus* Forsk. from Maryland, showed that the Philippine mosquito is interfertile with the American populations. Low hatching in F_1 egg-rafts laid by Philippine females mated with typical *pipiens* males was probably a result of reduced mating activity [*cf. R.A.E.*, B **43** 68], but the larvae that hatched and larvae from all other crosses developed normally. Survival rates of the hybrid larvae and pupae were comparable to those of the parent strains. All F_1 hybrids produced vigorous F_2 and back-cross colonies. It is concluded that *C. p. fatigans* from Luzon is conspecific with *C. p. pipiens*, *C. p. molestus* and *C. p. fatigans* from North America.

Clyde (D. F.) & Shute (G. T.). **Selective feeding habits of Anophelines amongst Africans of different ages.**—*Amer. J. trop. Med. Hyg.* **7** no. 5 pp. 543–545, 6 refs. Baltimore, Md., 1958.

It has been demonstrated in the West Indies and West Africa that Anophelines prefer to feed upon adults, the biting frequency being directly related to the age of the victim [*cf. R.A.E.*, B **42** 86, 102; **43** 48].

Observations were made in Tanganyika on the selective feeding habits of *Anopheles gambiae* Giles and *A. funestus* Giles among Africans of different ages, and the following is based on the authors' summary of the results. In 26 night catches, 695 blood-fed females of *A. gambiae* and *A. funestus* were taken in huts containing 3, 4, or 5 Africans, whose ages ranged from 6 months to 65 years, and who were sleeping under natural conditions in a district where the average number of inhabitants of a hut is 3·3. By correlation of the leucocyte counts of the blood of the human occupants of the hut with those of the blood in the stomach of the fed mosquito [**43** 207], it appeared that there was no consistent attraction of Anophelines to certain human age-groups.

Kokernot (R. H.), Smithburn (K. C.), de Meillon (B.) & Paterson (H. E.). **Isolation of Bunyamwera virus from a naturally infected human being and further isolations from** *Aedes* (*Banksinella*) *circumluteolus* **Theo.**—*Amer. J. trop. Med. Hyg.* **7** no. 6 pp. 579–584, 13 refs. Baltimore, Md., 1958.

Bunyamwera virus [*cf. R.A.E.*, B **37** 150; **48** 70] was isolated, for the first time from man, from the blood of a naturally infected youth at Ndumu, Tongaland, in 1957. The following is based on the authors' summary and discussion. The infection was demonstrated by the isolation of the virus from blood taken during the acute illness, and by the occurrence of a significant increase, following the attack, in both antibodies that neutralised the homologous agent and antibodies that inhibited agglutination of the blood. Three strains of this virus were isolated from *Aëdes circumluteolus* (Theo.), and two of these were from mosquitos collected at the same time and place at which the youth had acquired the infection.

Perry (A. S.) & Buckner (A. J.). **Biochemical investigations on DDT-resistance in the human body louse,** *Pediculus humanus humanus*.—*Amer. J. trop. Med. Hyg.* **7** no. 6 pp. 620–626, 1 fig., 21 refs. Baltimore, Md., 1958.

The acquired resistance of *Pediculus humanus humanus* L. to DDT has been reported [*R.A.E.*, B **47** 152, etc.]. Tests were carried out in Georgia to determine the factors involved in the resistance to DDT of a Korean strain of lice [*cf.* **41** 106; **44** 18; **46** 168] that had been maintained under DDT selection in a laboratory for several years, and the following is mainly the authors' summary of the results. DDT was found to be absorbed very slowly from acetone or benzene solutions applied topically to both susceptible and DDT-resistant lice. The resistant strain could tolerate larger quantities of DDT without any appreciably harmful effect. The feeding of lice, through dissected chick skins on citrated human blood containing various concentrations of radioactive DDT (containing ^{14}C) showed that the resistant strain could tolerate 100 parts DDT per million in the blood, whereas 10 p.p.m. caused 53 per cent. mortality in the susceptible strain. Resistant lice, but not susceptible ones, metabolised DDT *in vivo* to a relatively non-toxic material that was not extractable with common organic solvents but partly extractable with methanol. Treatment of the metabolite by the Schechter-Haller method [**35** 196] yielded a nitrated product, which, unlike DDT, DDE or DDA, was removable from solution by dilute alkali. Homogenates and acetone powders of both susceptible and DDT-resistant lice metabolised DDT *in vitro* at about the same rate, producing a non-toxic, water-soluble metabolite that gave a red-coloured complex in the Schechter-Haller procedure and had solubility characteristics similar to those of the metabolite obtained *in vivo*. It appears that an intrinsic biochemical factor, which presumably interferes with the detoxifying mechanism, might be operative in the susceptible strain. This interference is manifested *in vivo* but not *in vitro*.

WILLIAMS (R. W.). **An infestation of a human habitation by** *Dermanyssus gallinae* **(Degeer, 1778) (Acarina: Dermanyssidae) in New York City resulting in sanguisugent attacks upon the occupants.**—*Amer. J. trop. Med. Hyg.* **7** no. 6 pp. 627–629, 10 refs. Baltimore, Md., 1958.

The following is mainly based on the author's summary. Although marked dermatitis is common in some persons that become closely associated with the bird mite, *Dermanyssus gallinae* (Deg.), there is little evidence that this mite will ingest human blood [*cf. R.A.E.*, B **39** 71]. The invasion of an apartment in New York City by these mites in 1957 resulted in attacks on the occupants. The apartment was in an area where pigeons, which are a common host of *D. gallinae*, were more numerous than usual; the birds were known to drink from pools of water near a loose-fitting bathroom window, through which the mites apparently entered the apartment. The finding of mammalian erythrocytes in the digestive tract of mites, some of which were taken from the bed of the occupants, as well as the appearance of fresh blood spots on the bed sheets resulting from crushed mites that had recently fed, afford evidence that *D. gallinae* may, on occasion at least, partake of human blood.

BREMNER (K. C.). **Observations on the biology of** *Haemaphysalis bispinosa* **Neumann (Acarina: Ixodidae) with particular reference to its mode of reproduction by parthenogenesis.**—*Aust. J. Zool.* **7** no. 1 pp. 7–12, 18 refs. Melbourne, 1959.

The following is virtually the author's summary. It was shown in investigations in Queensland that *Haemaphysalis bispinosa* Neum. reproduces by obligatory parthenogenesis. Male ticks were found to be scarce in both experimental and natural infestations, occurring in the ratio of one to approximately every 400 females. Dissections of five males showed that these produced no spermatozoa, irrespective of whether they were fed or not. Rates of development of the non-parasitic stages under controlled conditions are recorded.

GALLIARD (H.). **Mortalité chez les culicidés infestés par** *Dirofilaria immitis* **et** *Wuchereria bancrofti*.—*Z. Tropenmed. Parasit.* **8** pt. 4 pp. 476–485, 3 graphs, 19 refs. Stuttgart, 1957. (With summaries in English & German.)

The following is substantially the author's summary. In Tonkin, the effects of the development of *Wuchereria bancrofti* and *Dirofilaria immitis* in *Aëdes aegypti* (L.), *A. albopictus* (Skuse), *Culex pipiens fatigans* Wied., *Armigeres obturbans* (Wlk.) and *Anopheles hyrcanus sinensis* Wied. were studied in 1936–44. At 28–31°C. [82·4–87·8°F.], mortality was heavy in the mosquitos infected with *D. immitis* during the first five days [*cf. R.A.E.*, B **42** 202], when the Malpighian tubules were being invaded, but some mosquitos survived till the 40th day. Mortality also varied with the rate of infection of the dogs used as sources of infection. At 18–22°C. [64·4–71·6°F.], mortality during the first five days was less, even when infection with microfilariae was heavy, and some mosquitos lived for up to 52 days. At the higher temperatures, mortality due to the microfilariae of *W. bancrofti*, which develop entirely in the thoracic muscles, was much less, and the mosquitos survived longer. The formation and development of the infective larvae of either species did not influence the death-rate during the first five days. There is no relation between mortality and the ability of a mosquito to carry infection of *D. immitis* up to the infective stage; thus in *Armigeres*, in which the development of microfilariae is rapidly inhibited, mortality was much heavier than in the other mosquitos, owing to early invasion of the Malpighian tubules and the quantity of blood and microfilariae ingested by such a large mosquito. The early mortality of the females is much reduced when they are not fertilised.

RAHM (U.). **Die attraktive Wirkung der vom Menschen abgegebenen Duftstoffe auf** *Aedes aegypti* **L.** [The attractive effect of the odour given off by man on *A. aegypti*.]—*Z. Tropenmed. Parasit.* **9** pt. 2 pp. 146–156, 8 figs., 16 refs. Stuttgart, 1958. (With a summary in English.) **Die Funktion der Antennen, Palpen und Tarsen von** *Aedes aegypti* **L. beim Aufsuchen des Wirtes.** [The function of the antennae, palps and tarsi of *A. aegypti* in the search for a host.]—*Rev. suisse Zool.* **65** fasc. 3 pp. 779–792, 3 figs., 13 refs. Geneva, 1958.

The following paragraphs are based on the author's summaries of these two papers, respectively.

Earlier investigations had shown that the olfactory substances secreted through the human skin play an important part in attracting *Aëdes aegypti* (L.) [*cf. R.A.E.*, B **47** 195, etc.]. In comparative tests, male persons had proved more attractive than females. The present paper comprises an account of studies on the attractiveness of the olfactory substances of both sexes under identical conditions of moisture and heat; the results showed that these substances alone are responsible for the greater attractiveness of men as compared with women.

Cage tests of different kinds showed that females of *A. aegypti* are able to distinguish between a human hand and a damp, warm bottle [*cf. loc. cit.*] and prefer the hand. Successive amputation of the joints of the antennae led to progressive weakening of the preference, but the bottle was still perceived by those possessing a few joints. Alternative-choice tests indicated that receptors for odours and for heat and moisture are present on the antennae, but differences between men and women were not detected by mosquitos with partly amputated antennae. The tarsi of the third pair of legs [*cf.* **40** 82] and the palps were of no importance for perception at a distance.

MAHFOUZ (M. S.). **Die Wirkung einiger Insektizide auf die Larven von** *Aedes aegypti* **L.** [The effect of several insecticides on the larvae of *A. aegypti*.]—*Z. Tropenmed. Parasit.* **9** pt. 2 pp. 156–162, 1 graph, 7 refs. Stuttgart, 1958. (With a summary in English.)

The following is based on the author's summary. Tests showed that the concentrations in parts per million killing 50 per cent. of the fourth-instar larvae of *Aëdes aegypti* (L.) were 0·014 for Chlorthion, 0·019 for diazinon, 0·032 for dieldrin, 0·13 for malathion, 0·165 for trichlorphon (Dipterex) and

0·175 for DDT. Except for DDT, the variation in replicate tests was within normal limits.

Zivkovitch [Zhivkovit'] (V.). **Neuere Beiträge zur Ökologie der Kolumbatscher Mücke** (*Simulium columbaczense*, **Fabricius 1787).** [New contributions on the ecology of *S. colombaschense*.]—*Z. Tropenmed. Parasit.* **9** pt. 3 pp. 193–200, 11 refs. Stuttgart, 1958. (With a summary in English.)

Details are given of observations on the conditions in which *Simulium colombaschense* (F.) (*columbaczense* (Schönb.)) breeds in the Iron Gate section of the Danube in Yugoslavia and of the ecology of the adults. The eggs of this Simuliid are difficult to find, but, after laboratory tests had indicated that few were laid in the water, they were eventually detected on roots of poplar and willow trees, on submerged branches and on branches put in water 1–2 days previously, and on grass and damp soil close to the river bank. They occurred singly or in small groups, with no mucilage, and were commonest away from the Iron Gate, although larvae and pupae are commonest there [*cf. R.A.E.*, B **27** 85]. Two generations of the Simuliid occurred in 1948 and 1949, owing to excessive rain in late spring.

Rehm (W. F.), Garms (R.) & Weyer (F.). **Zur Nachwirkung von Dieldrin bei** *Anopheles*-**Larven.** [The after-effects of dieldrin on *Anopheles* larvae.]—*Z. Tropenmed. Parasit.* **9** pt. 3 pp. 200–204, 5 refs. Stuttgart, 1958. (With a summary in English.)

In laboratory observations on the after-effects of treatment of fourth-instar larvae of *Anopheles labranchiae atroparvus* van Thiel, *A. stephensi* List. and *A. gambiae* Giles with dieldrin, larvae that survived a concentration of 0·007 or more parts dieldrin per million gave rise to adults of which none reproduced, or, if eggs were laid by them, these failed to hatch. When the concentration was reduced to 0·005 p.p.m., over 90 per cent. of the larvae of *A. stephensi* survived, but there was about 10 per cent. mortality of pupae due to the insecticide and 75 per cent. of the males and 44 per cent. of the females failed to emerge successfully. The surviving females laid reduced numbers of eggs, and few of the resulting larvae pupated. No adults were obtained from larvae of *A. l. atroparvus* or *A. gambiae* subjected to 0·005 p.p.m. dieldrin, but more severe results than those obtained with *A. stephensi* followed when the concentration was reduced to 0·002 p.p.m., total mortality reaching 95, 99 and 39 per cent., respectively. Adults of *A. l. atroparvus* from treated larvae laid viable eggs, however.

Dias (E.) & Dias (N. P.). **Ausrottung von Raubwanzen in Bambui, Brasilien.** [Extermination of Triatomines in Bambui, Brazil.]—*Z. Tropenmed. Parasit.* **9** pt. 4 pp. 291–293. Stuttgart, 1958. (With a summary in English.)

Triatoma infestans (Klug) and *Panstrongylus megistus* (Burm.), which transmit Chagas' disease (*Trypanosoma* (*Schizotrypanum*) *cruzi*), were practically eliminated from the district of Bambui, in the State of Minas Gerais, Brazil, by spraying the walls of houses with 5 per cent. BHC 2–3 times at monthly intervals between August 1956 and February 1957.

Hatch (C.). **The control of warble fly (*Hypoderma* spp.) in cattle in Ireland by oral administration of "Trolene" (Dow ET-57).**—*Irish vet. J.* **12** no. 8 pp. 150–156, 2 refs. Dublin, 1958.

The following is substantially the author's summary. Two trials were made to test the efficacy of fenchlorphos (Trolene) administered in a bolus against *Hypoderma* larvae in cattle near Dublin in 1957–58. It was found that a single dose at the rate of 5 g. fenchlorphos per 100 lb. body weight caused a reduction of 97·4 per cent. in the number of larvae that reached the back when administered in mid-September, and one of 92·8 per cent. when administered in early November. No toxic effects were observed in any of the treated animals.

Wichmann (R. W.) & Vincent (D. J.). **Cnemidocoptic mange in the budgerigar** (*Melopsittacus undulatus*).—*J. Amer. vet. med. Ass.* **133** no. 10 pp. 522–524, 2 figs., 6 refs. Chicago, Ill., 1958.

Cnemidocoptes pilae Lavoipierre & Griffiths, which causes mange in budgerigars (*Melopsittacus undulatus*) [*cf. R.A.E.*, B **46** 56, etc.], has a wide distribution in the United States. Current information on the mite and the symptoms caused is reviewed, and the following is taken from the authors' summary of work on control. Observations were made on the effect of seven materials. N-ethyl-o-crotonotoluide at 10 per cent. in a vanishing-cream base was found to be effective and non-toxic to the budgerigars. Benzyl benzoate as a 25 per cent. emulsion prepared in the laboratory was also effective, but a commercial preparation was toxic to the birds, as likewise were two organophosphates and γ BHC in dips.

Papers noticed by Title only.

Cummings (E. C.) & Menn (J. J.). **An American cockroach** [*Periplaneta americana* (L.)] **rearing cage.**—*J. econ. Ent.* **52** (1959) no. 6 pp. 1227–1228, 3 figs. Menasha, Wis., 1960.

Harshbarger (J. C.) & Raffensperger (E. M.). **A method for collecting and counting populations of the shaft louse** [*Menopon gallinae* (L.) on fowls].—*J. econ. Ent.* **52** (1959) no. 6 pp. 1215–1216, 1 fig., 3 refs. Menasha, Wis., 1960.

Iyengar (M. O. T.). **A review of the literature on the distribution and epidemiology of filariasis** [due to *Wuchereria bancrofti* and *W. malayi*] **in the South Pacific region.**—*Tech. Pap. S. Pacif. Comm.* no. 126, [3 +] 172 pp., multigraph. Nouméa, 1959.

Iyengar (M. O. T.). **Annotated bibliography of filariasis and elephantiasis Part 5. Prophylaxis and control of filariasis due to *Wuchereria bancrofti* and *W. malayi*.**—*Tech. Pap. S. Pacif. Comm.* no. 129, vii + 102 pp., multigraph. Nouméa, 1960. [*Cf. R.A.E.*, B **44** 181; **48** 84, etc.]

Belozerov (V. N.). **The effect of humidity on the mite *Ornithonyssus bacoti* Hirst (Parasitiformes, Liponyssidae).** [*In Russian.*]—*Rev. Ent. URSS* **37** pt. 1 pp. 47–63, 12 graphs, 30 refs. Moscow, 1958. (With a summary in English.)

Warry (J. P.). **Pesticides quarterly supplement no. 11, August, 1960.**—pp. 487–510, 33 refs., multigraph. [Canberra] Dep. Hlth Aust., 1960. [*Cf. R.A.E.*, B **41** 77; **43** 208.]

BYRD (E. E.) & ST. AMANT (L. S.). **Studies on the epidemiology of filariasis on central and south Pacific islands.**—*Tech. Pap. S. Pacif. Comm.* no. 125, v+90 pp., 7 pls., 15 refs., multigraph. Nouméa, 1959.

A detailed account is given of observations made in 1943–44 on filariasis in American Samoa, the Wallis Islands, the New Hebrides and the Solomon Islands. Microfilaria rates were determined by examination of a representative sample of the local native population; the local mosquito vectors, and where possible the incidence of natural infection in them, and their transmitting efficiency were determined, and their breeding, feeding, resting and flight habits were studied. As far as possible, all mosquitos seen were collected and dissected. Day-feeding mosquitos were collected from likely resting places as well as from man and other hosts, and night-feeding mosquitos were collected in the early morning from huts and other resting places in and near a village. Observations are recorded on the habits of *Aëdes polynesiensis* Marks (*pseudoscutellaris*, auct.) [*cf. R.A.E.*, B **41** 161] in Samoa [*cf.* **43** 205] and *Anopheles farauti* Lav. in the New Hebrides [*cf.* **34** 122; **36** 84] and Guadalcanal, with brief notes on other species. In this survey and others with which the authors were associated, 5,578 people were examined and 16·05 per cent. found to be infected. The filaria involved was *Wuchereria bancrofti*, except that Tonkinese labourers harboured *W. malayi*, the local vectors of which are not known.

The most extensive studies on mosquitos were made in Samoa, where only the non-periodic strain of the parasite occurs; six species were examined, and infection was found in 0·8 per cent. of *Aëdes aegypti* (L.), 7·4 per cent. of *Culex pipiens fatigans* Wied. and 10·7 per cent. of *A. polynesiensis*. Consideration of the distribution of the last two and the degree of development of the filarial larvae found in them and experimental feeding of *A. polynesiensis* on a carrier confirmed that this species alone appears to transmit *W. bancrofti* in American Samoa [*cf.* **42** 91; **44** 132]. The natural infection rate in it was about the same (13 per cent.) in native village areas and in camp-village areas in which United States forces and the local inhabitants were fairly closely associated but was negligible in U.S. camp areas situated at a safe distance from native villages. Simple control measures (removing breeding places and keeping vegetation cropped short) reduced the density of *A. polynesiensis* in the camp areas to 19 mosquitos per man per hour, as compared with 129 in the uncontrolled native villages.

About 2·6 per cent. of all females examined contained infective larvae; the percentages during the dry months were about double those in the early rains, and the monthly figures are considered to indicate that maximum transmission occurs during the last half of the rainy and the first half of the dry period. Mortality of naturally and experimentally infected females of *A. polynesiensis* was heavy in the first 4–5 days of infection [*cf.* **49** 41]. All infective larvae were not lost at a single feeding except when infection was light.

In Uvea (Wallis Islands) also, the microfilariae are non-periodic and the day-biting *A. polynesiensis* appears to be the only important vector. Of 2,645 females examined, 7·3 per cent. were infected. The infection rate in the native village was almost the same as in Samoa, and the rates for the camp-village and camp areas were, respectively, lower and higher than in Samoa. The last finding is attributed to the employment of natives in the camps and their tendency to loiter there. Although mosquito densities in the controlled areas of Wallis and Samoa were almost identical, the density for the uncontrolled area and the over-all density were lower in the former. Only 0·19 per cent. of females of *A. polynesiensis* from the vicinity of the native village harboured infective larvae, though the incidence of infection in man is believed to be about the same as in Samoa.

In the New Hebrides and Solomon Islands, only the strain of *W. bancrofti* with nocturnal periodicity is present. Seven out of nine species of mosquitos examined in the New Hebrides were found to harbour larvae, the infection rates ranging from 3·45 per cent. in *A. scutellaris* (Wlk.) (*hebrideus* Edw.) to 20 per cent. in *A. aegypti*, but development to the infective stage was completed only in *Anopheles farauti*, a night-biting species that had an infection rate of 13·72 per cent. and an infective rate of 0·4 per cent. in females examined from the uncontrolled area. It is concluded that *A. farauti* is the vector. The numbers of females of this species caught per man per hour were 62 in the uncontrolled and 14 in the controlled area. Survival of infected females followed the same trend as in *Aëdes polynesiensis* in Samoa. Evidence is given that all infections of the mosquitos were with *W. bancrofti* acquired from the Melanesian population and not with *W. malayi* acquired from the Tonkinese.

Among 1,494 mosquitos of ten species examined from unoccupied parts of Guadalcanal (Solomon Islands), four species numerous enough to be potentially important were represented. These included *Anopheles farauti*, *Mansonia uniformis* (Theo.) and *A. koliensis* Owen, of which 340 out of 655, 90 out of 385 and 17 out of 351, respectively, contained developing larvae of *W. bancrofti*. Infective larvae were found in 4·27 per cent. of the total of *A. farauti* [cf. **40** 157] and in one female of *A. koliensis*. *A. punctulatus* Dön. was fairly abundant but not found infected. Four out of 24 females of *A. farauti* and 17 out of 239 of *A. punctulatus* were infected experimentally by feeding on a carrier of *W. bancrofti* from the Gilbert Islands, where infection is mainly nocturnal, as in the Solomon Islands. Three of the infections were found on the first day after feeding and one on the sixth in *A. farauti* and five on the first and 12 on the second in *A. punctulatus*.

In every case in which the rate of infection was determined for both the native population and the uncontrolled mosquito population, the rate of infection with blood microfilariae in the people was lower than the infection rate in the principal mosquito vector. In two situations on the fringe of the controlled area on Espiritu Santo (New Hebrides), on the other hand, the infection rate in *A. farauti* was lower than the microfilaria rate in the human population, and the infections in the mosquitos were all in early stages. It would appear, therefore, that the spraying that was being carried out against adult Anophelines as an anti-malaria measure was completely effective in preventing the transmission of *W. bancrofti*. Higher infection rates were found in *A. farauti* than in *Aëdes polynesiensis* because the night-feeding *Anopheles* females were collected while resting after a blood-meal, so that the catches included recently fed individuals, whereas the *Aëdes* females were caught only as they attempted to feed. The factors affecting infection rates of, and the relations between, insect vector and human host are discussed; the only source of infection for the mosquito is the native population, and the village in an endemic area is a hyperendemic focus of infection. The prospects of controlling the two chief vectors are discussed.

ALEXANDER (E. R.) & MURRAY jr. (W. A.). **Arthropod-borne encephalitis in 1956.**—*Publ. Hlth Rep.* **73** no. 4 pp. 329–339, 5 figs., 9 refs. Washington, D.C., 1958.

The prevalence of the different forms of arthropod-borne encephalitis in the United States in 1956 is surveyed. Eastern equine encephalitis occurred sporadically in horses throughout the Atlantic and Gulf States, but there were few human cases. The virus was isolated from five pools of unengorged females of *Culiseta melanura* (Coq.) from Massachusetts and two of unengorged and one of engorged females of the same species and two of engorged females of *Culex salinarius* Coq. from New Jersey [*R.A.E.*, B **48** 223]. These findings indicate that *Culiseta melanura*, which is plentiful in both States, and feeds mainly on birds, is probably the chief vector among them; it may occasionally effect transmission to man or horses [*cf.* **48** 219]. The virus was isolated for the first time from *Aëdes mitchellae* (Dyar) and a pool of *Culicoides* spp. and for the second time from *Anopheles crucians* Wied. [*cf.* **44** 136], all from Georgia. Western equine encephalitis occurred sporadically in the western States, with 47 reported (including 37 confirmed) human cases, and there were epidemics in horses. Infection was also found in wild birds in Rhode Island, New Jersey and Louisiana. The virus was isolated from 304 pools of *Culex tarsalis* Coq. from various States, one pool of *Culiseta melanura* from New Jersey [**48** 223] and two of *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) [*cf.* **46** 160] from Texas. A large urban epidemic of St. Louis encephalitis in Kentucky and a rural one in Texas made this the most important form of arthropod-borne encephalitis in 1956. The virus was isolated 26 times from pools of *C. tarsalis* [*cf.* **48** 63–64] from widely distributed foci, but none of them in either of the epidemic areas.

RIEK (R. F.). **Studies on the reactions of animals to infestation with ticks. IV. The protein components of tick extracts.**—*Aust. J. agric. Res.* **10** no. 4 pp. 604–613, 7 figs., 15 refs. Melbourne, 1959. **V. Laboratory animals as hosts for the cattle tick,** *Boophilus microplus* **(Canestrini).**—*T. c.* pp. 614–619, 2 pls., 5 refs.

The following paragraphs are substantially the author's summaries of these fourth and fifth parts of a series [*cf. R.A.E.*, B **48** 101]. Filter-paper and starch electrophoresis and gel diffusion have been used to separate and identify the various protein components of extracts of *Boophilus microplus* (Can.). Changes in the relative protein composition with increasing age of the eggs and larvae of the tick were revealed by filter-paper electrophoresis. Toxicity for laboratory animals was due on most occasions to three fractions, F_1, F_2 and F_6, in the egg extract, but only to one fraction, F_{2-3}, in the larval extract. On a few occasions the α-globulin, F_6 (haemixodovin), was non-toxic. The reason for the apparent variation in toxicity of this fraction is not understood. Toxicity decreased with age of both eggs and larvae, larvae 14 days old being relatively non-toxic. The gel-diffusion tests showed the presence of similar or closely related components in the egg and larval extracts. Immunisation with larval extracts prevented the toxic effects of the egg extracts. The antigen largely responsible for the development of skin hypersensitivity, F_1, was also one of the toxic components, and was the γ-globulin that had the greatest mobility under these specified electrophoretic conditions. Skin-sensitising activity was also shown by fraction F_2, and to a smaller degree by F_3, but this may have been due to incomplete separation of the individual components.

When a rubber collar was fitted to prevent the animal from biting and scratching, *B. microplus* developed successfully on white mice and rabbits, but not on guineapigs. Development on mice was little slower than on cattle, but mortality of larvae and nymphs was high, and replete females were less than half the normal weight. There was an inconstant reaction to attachment of larvae, consisting of cellular infiltration, in which the invading cells were mainly mononuclear, but a more acute one, in which polymorphonuclear lymphocytes predominate, to nymphs and adults, and a tendency to wall off the haustellum of the tick by ingrowing epithelium or inflammatory tissue.

FOGGIE (A.). **Studies on the relationship of tick-bite to tick pyaemia of lambs.**—*Ann. trop. Med. Parasit.* **53** no. 1 pp. 27–34, 1 pl., 1 fig., 14 refs. Liverpool, 1959.

The reaction and changes in the layers of the skin of lambs to feeding by sheep ticks (*Ixodes ricinus* (L.)) are described from a study of sections of pieces of skin with the ticks attached. The mouth-parts do not appear to penetrate a blood-vessel directly, nor is there extensive damage to the blood-vessels by the chelicerae, as there is in Argasids [*cf. R.A.E.*, B **44** 180]. The presence of anticoagulant and oedema-producing properties in extracts of the salivary glands of the tick, which had been noted by earlier workers, was confirmed.

No secondary abscess formed after the feeding of ticks on lambs' skin contaminated with the staphylococcus responsible for pyaemia [*cf.* **28** 52–53] or after the intradermal inoculation of staphylococci with salivary-gland extract into normal lambs or lambs in the neutropenic phase of tick-borne fever [**24** 249–250, etc.], a disease stated to be caused by a rickettsia-like organism, although the susceptibility of lambs to intravenously administered staphylococci is enhanced during the neutropenic phase. These experiments and the absence of correlation between numbers of cases of pyaemia and degree of tick infestation on farms in Britain suggest that the causal staphylococcus gains access to the blood-stream by some route unconnected with tick-bite.

GILLETT (J. D.), HADDOW (A. J.) & CORBET (P. S.). **Observations on the oviposition-cycle of** *Aëdes* (*Stegomyia*) *aegypti* **(Linnaeus), II.**—*Ann. trop. Med. Parasit.* **53** no. 1 pp. 35–41, 1 fig., 3 refs. Liverpool, 1959.

The following is substantially the authors' summary of continued observations on the oviposition cycle of *Aëdes aegypti* (L.) [*cf. R.A.E.*, B **46** 192]. Under conditions of normally fluctuating 12-hour equatorial day and night, *A. aegypti* shows a regular oviposition cycle, with a peak of activity towards the end of the afternoon. This peak retains the same relation to light and darkness when these are artificially reversed. Cyclical behaviour is maintained when the duration of light is decreased, even when it is only four hours per day, or when it is increased, even to 20 hours per day; it breaks down, however, in constant darkness or light. Pilot experiments indicated the possibility of the existence of an endogenous 24-hour rhythm, but it is clear that this becomes apparent only in the presence of alternating light and darkness. Some implications of these experiments are briefly discussed.

JORDAN (P.). **The possible rôle of low-density microfilaraemia in the spread of** *Wuchereria bancrofti* **by** *Culex fatigans* **in East Africa.**—*Ann. trop. Med. Parasit.* **53** no. 1 pp. 42–46, 9 refs. Liverpool, 1959.

When females of *Culex pipiens fatigans* Wied. of a strain originating in Mwanza township, Tanganyika, were fed on people with very few microfilariae of *Wuchereria bancrofti* in their blood, infective larvae sometimes developed. When, in a second series of experiments, diethylcarbamazine was given to persons with microfilariae in their blood at various intervals before the mosquitos were allowed to feed, the microfilarial count was greatly reduced, but some embryos always remained in circulation, and infective, apparently normal filarial larvae developed. In two further experiments, diethylcarbamazine in a second blood-meal taken by the mosquito one week after an infective one did not prevent the larvae developing in the mosquito from reaching the infective stage. These results suggest that, in eradication schemes in which diethylcarbamazine is used, even people with very few microfilariae in their blood should be treated and complete clearance of microfilariae from the blood of all persons in the treated area should be aimed at, especially in areas with a high mosquito biting rate.

Webbe (G.) & Shute (G. T.). **A further note on the action on fish of chlorinated hydrocarbons when used as larvicides.**—*Ann. trop. Med. Parasit.* **53** no. 1 pp. 47–50, 4 refs. Liverpool, 1959.

The results are given of continued investigations in Tanganyika on the action of formulations of DDT, BHC, aldrin and dieldrin for use as mosquito larvicides on three species of *Tilapia* [*cf. R.A.E.*, B **47** 4]. Dusts containing 5 per cent. DDT or 2·5 per cent. aldrin or dieldrin and granules containing 2 per cent. dieldrin caused no mortality among the fish when each was applied weekly in experimental ponds, 48 sq. yd. in area, at a dosage of 1 lb. dust or granules per acre per application for 20 weeks. Breeding was unimpaired. There was some retardation in growth among the fish, but this is thought to have been due to the smallness of the ponds and consequent shortage of food and not to the insecticides. A single application of the aldrin or dieldrin dust at 5 lb. per acre caused no significant mortality in three weeks, but one at 10 lb. caused 60 per cent. mortality or more, *T. macrochir* and *T. melanopleura* being more susceptible than *T. pangani*. A larvicide powder containing 3 per cent. γ BHC, applied weekly at a dosage of 1 lb. per acre for 20 weeks, produced no mortality among fish in a stock pond, and neither breeding nor growth was apparently affected. No deterioration in taste was detected in samples of *Tilapia* tested at the end of the 20 weekly treatments with any of the insecticides.

McDonald (W. A.) & Wijers (D. J. B.). **Anal feeding as a method of infecting tsetse-flies with** *Trypanosoma gambiense*. **I. The technique.** —*Ann. trop. Med. Parasit.* **53** no. 1 pp. 69–71, 1 pl., 2 refs. Liverpool, 1959.

The following is based largely on the authors' summary. A technique is described for infecting *Glossina palpalis* (R.-D.) with *Trypanosoma gambiense* by injecting infective blood through the anus of the fly from a micro-pipette with a fire-polished tip of about 150 μ outer diameter. One initial anal feed did no harm, and a gland infection rate of 15·8 per cent. was obtained among 82 anally fed flies, as against 5·7 per cent. among 88 flies that had fed naturally on the same monkey on their first day of life. Anal injection of an unfed newly emerged fly with acid fuchsin showed penetration of the dye up the mid-gut nearly to the proventriculus, and it was thought that the anal injection of infective blood would facilitate infection with trypanosomes of the group of *T. brucei* by sparing them the normal journey down the gut before passing round the free end of the peritrophic membrane and shorten their return journey to the salivary glands. Flies infected by anal feeding transmitted the infection by bite to a previously uninfected monkey.

NASH (T. A. M.) & JORDAN (A. M.). **A guide to the identification of the West African species of the *fusca* group of tsetse-flies, by dissection of the genitalia.**—*Ann. trop. Med. Parasit.* **53** no. 1 pp. 72–88, 12 figs., 3 refs. Liverpool, 1959.

The diagnostic features of the male hypopygium and female signum of the six West African species of *Glossina* of the group of *G. fusca* (Wlk.) are given, and a mounting technique is described for showing a dorsal view of the hypopygium and extended phallosome by means of which the males of the different species could be rapidly identified. Identification of the females is complicated by the wide range of variation in the signum, and details are given of this variation for each species.

KIRK (R.), MORGAN (H. V.), HASEEB (M. A.) & SATTI (M. H.). **Onchocerciasis in the Sudan Republic.**—*Ann. trop. Med. Parasit.* **53** no. 1 pp. 97–102, 31 refs. Liverpool, 1959.

Present knowledge on the distribution of onchocercosis (caused by *Onchocerca volvulus*) in the Sudan is reviewed, and notes are given on the principal clinical features seen there, on treatment, and on the breeding habits of the vector, *Simulium damnosum* Theo., and its flight range [*R.A.E.*, B **39** 66, 178; **41** 38–39]. The authors do not believe that there is great danger that it can carry the disease over long distances [*cf.* **36** 148], as it has been suggested that flight range may be reduced by the presence of developing *Onchocerca* in the thoracic muscles of the vector, and as the infrequence of infections in man suggests that prolonged exposure is needed to produce serious manifestations. The possibility of controlling onchocercosis in the Sudan by attacking the vector is briefly discussed. Even partial control of *S. damnosum* might be of value in preventing blindness by reducing the intensity of infection. It may be impracticable to destroy it with insecticides during the rainy season [**41** 39], but the possibility of attacking the small numbers that carry the population through the dry season [**39** 66; **41** 38] could be studied. Where the *Simulium* season is short, as it is in the Northern Sudan [**48** 63], the use of diethylcarbamazine to eliminate microfilariae from the skin might help to break the cycle of transmission.

HADDOW (A. J.), GILLETT (J. D.) & CORBET (P. S.). **Laboratory observations on pupation and emergence in the mosquito** *Aëdes* (*Stegomyia*) *aegypti* (**Linnaeus**).—*Ann. trop. Med. Parasit.* **53** no. 2 pp. 123–131, 3 graphs, 16 refs. Liverpool, 1959.

Two series, each of 700 larvae of *Aëdes aegypti* (L.) that had hatched during 10 minutes on one evening and during the same period after 12 hours, on the following morning, were reared in normal fluctuating daylight and were kept under hourly observation in individual numbered tubes from the beginning of the fourth instar. Pupation and the emergence of adults took place continuously over periods of 46–49 and 51–55 hours, respectively, with no trace of a 24-hour rhythm in either series. The duration of the male larval and pupal stages was shorter than that of the female ones by about 8–10 hours (about 5 per cent.) and about 2–3 hours (about 4 per cent.), respectively. Those individuals that spent longest in the larval stage were almost always those that spent longest in the pupal stage.

Gillett (J. D.), Corbet (P. S.) & Haddow (A. J.). **Observations on the oviposition-cycle of** *Aëdes* (*Stegomyia*) *aegypti* (**Linnaeus**), **III.**—*Ann. trop. Med. Parasit.* **53** no. 2 pp. 132–136, 1 graph, 10 refs. Liverpool, 1959.

It has already been shown that the oviposition cycle in *Aëdes aegypti* (L.), although endogenous, becomes apparent in the presence of alternating light and darkness [*R.A.E.*, B **49** 48]. Experiments described in the present paper showed that cyclical behaviour occurs even when the duration of light is only five minutes in 24 hours. When there was one hour's light or more in 24 hours, there were clear-cut oviposition cycles of characteristic pattern; when light periods lasted less than one hour, there were unusual oviposition cycles with tendencies towards drifting and double peaks. These and previous results are discussed in the light of recent work on 24-hour rhythms in other insects. Biting cycles in mosquitos follow characteristic patterns, and it is suggested that they also may have an endogenous basis and be suitable for study by methods similar to those used for oviposition cycles.

Ashcroft (M. T.). **The Tinde experiment: a further study of the long-term cyclical transmission of** *Trypanosoma rhodesiense*.—*Ann. trop. Med. Parasit.* **53** no. 2 pp. 137–146, 2 graphs, 25 refs. Liverpool, 1959.

Ashcroft (M. T.), Burtt (E.) & Fairbairn (H.). **The experimental infection of some African wild animals with** *Trypanosoma rhodesiense*, *T. brucei* **and** *T. congolense*.—*T.c.* pp. 147–161, 32 refs.

Ashcroft (M. T.). **The importance of African wild animals as reservoirs of trypanosomiasis.**—*E. Afr. med. J.* **36** no. 6 pp. 289–297, 15 refs. Nairobi, 1959.

It is stated in the first paper that, after 23 years of cyclical transmission by *Glossina morsitans* Westw. through 120 sheep, the Tinde strain of *Trypanosoma rhodesiense* [*cf. R.A.E.*, B **45** 83] was still infective to man. Two tsetses that fed on a number of volunteers in December 1956 and January 1957 failed to infect them, but this was probably because of the small number of metacyclic trypanosomes in their saliva, and six out of eight volunteers inoculated with infected rat blood at various times between November 1955 and November 1957 developed infection. Willett & Fairbairn's conclusion that the infectivity of the strain to man varies cyclically [*loc. cit.*] is rejected because they did not allow for the probability that the proportion of men that a single fly will infect depends not only on the infectivity of the strain but also on the number of metacyclic trypanosomes that the fly ejects while feeding [**37** 196]. The results, therefore, are not regarded as showing whether infectivity to man has changed. The relation between the morphologically identical *T. rhodesiense*, *T. gambiense* and *T. brucei* [*cf.* **47** 40] is discussed in the light of the results of the experiment. It is suggested that *T. rhodesiense* and *T. gambiense* are basically the same parasite, with physiological differences attributable to the fact that *T. gambiense* is mainly transmitted through man and that *T. rhodesiense* is a parasite of animals and also, though probably less often, of man. *T. brucei*, on the other hand, is considered distinct in that it can never infect man, although, except for this important difference, it has physiological properties similar to those of *T. rhodesiense* because both are primarily parasites of animals. This suggested relation is in accordance with the known habits of the vectors. *G. palpalis* and *G. tachinoides* Westw., the species that transmit *T. gambiense*, may feed in sleeping-sickness areas largely on man and reptiles [*cf.* **48** 41, 157], and as reptiles cannot be infected with polymorphic trypanosomes, these must be transmitted through man alone, and would become adapted to man and acquire the characters of *T. gambiense*. On the other hand, *G. morsitans*, *G. swynnertoni* Aust. and *G. pallidipes* Aust., the vectors of *T. rhodesiense*, rarely feed on man. It is probable that the only strains that are transmitted continuously by these tsetses are those that produce high parasitaemias in the hosts on which they feed. It seems unlikely that *T. gambiense* can do so in the animals that are the hosts of these three species of *Glossina*, and this is the reason for its absence from the areas in which they are the only vectors.

In the second paper, an account is given of attempts to infect a wide range of African wild animals with *T. rhodesiense*, *T. brucei* and *T. congolense*, mainly by single cyclically infected individuals of *G. morsitans*. The results showed that the infectibility of the animals and their susceptibility to *T. rhodesiense* and *T. brucei* varied considerably and strongly suggested the existence of a reservoir of *T. rhodesiense* in wild animals. The results are briefly compared with the extent to which the species concerned are fed upon by tsetse flies in nature. In the third paper, this is discussed in detail, and a table compiled from the literature is given showing the numbers and percentages of 27 animals from which infections with trypanosomes of the *brucei* group, *T. congolense* and *T. vivax* have been recorded and indices of the importance of 18 of the animals as hosts of tsetse and of 13 of them as reservoirs of trypanosomes. It is concluded that some animals, such as the wart-hog (*Phacochoerus aethiopicus*), may be less important as a reservoir of trypanosomes than might be expected from their importance as hosts of tsetse [**48** 128, etc.], whereas other animals, such as kudus (*Strepsiceros* spp.), giraffe or reedbucks (*Redunca* spp.), which are less important as hosts, may be more important as reservoirs. It is suggested that the numbers of tsetse flies carrying trypanosomes and the relative proportions in which they are infected with the different species of trypanosomes may be closely related to the kind of animals on which the tsetse feed.

DUKE (B. O. L.). **Studies on the biting habits of** *Chrysops*. **VI. A comparison of the biting habits, monthly biting densities and infection rates of** *C. silacea* **and** *C. dimidiata* **(Bombe form) in the rain-forest at Kumba, Southern Cameroons, U.U.K.A.**—*Ann. trop. Med. Parasit.* **53** no. 2 pp. 203–214, 4 graphs, 5 refs. Liverpool, 1959.

In continued studies on *Chrysops* [*cf. R.A.E.*, B **48** 185, etc.], various aspects of the biting habits of *C. silacea* Aust. and the Bombe form of *C. dimidiata* Wulp were compared in the rain-forest at Kumba in the Southern Cameroons. It was found that the presence of a wood fire increased the biting density of *C. silacea* at ground level in the forest 10·5 times and that of *C. dimidiata* 4·6 times. The catches of both species attributable to the effect of the fire alone showed the bi-phasic character typical for each, with morning and afternoon peaks occurring at the same times as in the canopy [*cf. loc. cit.*]. These findings lend support to the hypothesis, developed before the Bombe form of *C. dimidiata* had been differentiated from *C. silacea*, that wood smoke causes the biting population of the canopy to descend to ground level [**45** 82]. In the absence of a fire, *C. dimidiata* was more efficient than *C. silacea* at finding stationary human bait on the forest floor. The annual cycles of biting density of the two were markedly different. The biting population of *C. silacea* was high from April to December and low in the dry season (January to March), whereas that of *C. dimidiata* had two peak periods, one from November to January and the other from March to May, and dropped nearly to zero between June and October. The percentages of infection with *Loa* in females of *C. silacea* and *C. dimidiata* caught biting in the morning and (in brackets) in the afternoon over a period of 27 months were 5·3 (8·1) and 4·9 (6·6), respectively. This association of a significantly lower infection rate in the morning catches of *C. silacea*, although the numbers taken were higher than in the evening, suggested that a wave of nulliparous females of this fly bit in the morning. The *Chrysops* infection potential, as measured by the biting densities of infective females of the two species combined, which are recorded for the 27 months from June 1956 to August 1958, showed a peak occurring regularly in the months of April, May and June.

Lavoipierre (M. M. J.), Dickerson (G.) & Gordon (R. M.). **Studies on the methods of feeding of blood-sucking arthropods. I. The manner in which Triatomine bugs obtain their blood-meal, as observed in the tissues of the living rodent, with some remarks on the effects of the bite on human volunteers.**—*Ann. trop. Med. Parasit.* **53** no. 2 pp. 235–250, 2 pls., 7 figs., 41 refs. Liverpool, 1959.

The following is virtually the authors' summary. The literature on the feeding mechanism of blood-sucking arthropods is reviewed. Although there are some records of direct observation on the mode of feeding of phytophagous bugs, no such observations on the feeding-mechanism of haematophagous bugs have hitherto been made. An account is given of the mechanism of feeding of *Rhodnius prolixus* Stål, *Triatoma infestans* (Klug) and *T. protracta* (Uhl.). The techniques by which they were studied are described.

The bug pierces the skin of the host by rapid alternating movements of the mandibles, which are rigid structures and barbed at their tips. The mandibles, which act as anchors to the fascicle, penetrate only into the superficial tissues, where their movements immediately cease. They are promptly followed by the more slender and very flexible maxillary bundle, which penetrates deeply into the tissues, thrusting forward first in one direction and then in another. Haemorrhages are formed during probing, but they are not used for feeding, the maxillary bundle continuing its restless movements until a vessel of suitable calibre is encountered. Feeding takes place only from a blood-vessel, which is seen to pulsate as the insect sucks up its meal. It is suggested that the striking flexibility of the maxillary bundle may be due to the action of the protractor and retractor muscles upon the maxillae, which are unequal in form and capable of independent sliding movements.

The effect of the bites of two of the species was studied on previously unexposed subjects. In no case was any pain experienced, either during or after the bite, and an obvious immediate reaction was never observed. Of the 11 European volunteers, who allowed themselves to be further exposed to the bites of *R. prolixus* at irregular intervals over a period of many months, three developed a delayed reaction, which was severe only in one of the three subjects.

la Croix (E. A. S.). **A trial use of grass-mat passages in protecting humans from attacks by tsetse flies.**—*Bull. ent. Res.* **51** pt. 4 pp. 639–642, 2 refs. London, 1961.

The following is the author's summary. In March 1957, an outbreak of human sleeping sickness was discovered in the South Mamprussi District of northern Ghana. Temporary measures were initiated at a few villages to provide protection, at water-holes on streams, against attack by the two prevalent species of tsetse, *Glossina palpalis* (R.-D.) and *G. tachinoides* Westw., until clearings could be made. These measures consisted of grass-mat passages approximately 8 ft. high, extending from about 75 yd. from the stream down to and around the water-hole. At the water-hole, there was a gap of about 1 ft. between mat and water. These passages were found to be successful in excluding tsetse fly. This suggests several points of interest about *G. palpalis* and *G. tachinoides*: that at that time of year and in that type of vegetation, they do not rest higher than 8 ft. above ground; that the portions of human anatomy that showed beneath the matting did not attract the fly; and that these species depend on sight for hunting rather than on smell. The cost of this matting was negligible as compared with the cost of routine clearing, and this method of temporary protection was considered successful for its purpose.

Leggate (B. M.) & Pilson (R. D.). **The diurnal feeding activity of *Glossina pallidipes* Aust. in relation to trypanosome challenge.**—*Bull. ent. Res.* **51** pt. 4 pp. 697–704, 1 graph, 17 refs. London, 1961.

The following is substantially the authors' summary. The limitations of the use of apparent density of *Glossina*, here defined as the number of non-teneral males and females per 10,000 yd. [*R.A.E.*, B **48** 151, *cf.* also **42** 152], in estimating trypanosome challenge [**47** 41] or its index (apparent density multiplied by infection rate) are discussed, and it is concluded that such estimates should be based on the feeding portion of the tsetse population, its activity in relation to a given host, and the total period of feeding activity (or parts thereof) as the unit of time.

A method of investigating the diurnal feeding activity of *Glossina pallidipes* Aust. in the late dry season at Rekomitjie, in the Zambezi Valley in Southern Rhodesia, is described. A black ox was tethered daily under a large tree from before dawn until after dusk. Only flies that engorged on the ox were caught; the time of capture and sex of each fly was recorded, and the fly then marked and released. Catches were made on 15 separate but not consecutive days between 21st October and 30th November 1959. Diurnal activity extended from 4.45 a.m. to 6.45 p.m., there being a small early-morning peak, reduced activity over the midday period, and a comparatively large evening peak. Climatic factors were recorded, but no conclusions could be drawn about their separate effects on activity.

The infection rate of 613 non-teneral flies caught over the same period in the immediate vicinity of the experimental site was 9·8 per cent., and the mean number of non-teneral flies that fed on the ox per day (4.45 a.m. to 6.45 p.m.) was 289. Trypanosome challenge, calculated as the mean number of infected flies that fed per hour, was thus 2·02 over the whole day, but varied from 0·85 during the middle of the day (9.45 a.m. to 2.15 p.m.) to 1·63 in the early morning (4.45 to 9.45 a.m.) and 3·64 during the latter part of the day (2.15 to 6.45 p.m.). In these circumstances, the normal practice of grazing cattle in the early morning and watering them in the late evening would tend to increase the chance of infection.

Glasgow (J. P.) & Bursell (E.). **Seasonal variations in the fat content and size of** *Glossina swynnertoni* **Austen.**—*Bull. ent. Res.* **51** pt. 4 pp. 705–713, 3 graphs, 16 refs. London, 1961.

The following is largely based on the authors' summary. A population of *Glossina swynnertoni* Aust., at Shinyanga, Tanganyika, was studied in respect of size and fat content of non-teneral males by monthly samples over a period of 13 years (1945–58). The observations were begun by C. H. N. Jackson [*R.A.E.*, B **41** 39] and continued by the authors. Flies were found to be large from February to July and small from August to January, and this change in size suggests an effect of the wet season (December to May) and dry season (June to November) upon the parent females, with allowance for a time-lag of two months representing pupal development and mean age of adult males at capture. Male flies have more fat in the rains and less in the dry season, and it is possible that similar changes in the nutritional status of females are responsible for the observed size changes.

The correlation found in earlier work between the size of male flies in any month and saturation deficit two months earlier [*loc. cit.*] is confirmed, but the relation is not thought to be a simple causal one. Factors probably of more importance than the saturation deficit are the grass fires that usually run through the country in June or July, the shedding of leaves by many deciduous trees and the exhaustion of temporary supplies of water in the same months, with their influence on the activities of the mammalian hosts of the tsetse and the number of enemies that prey on it. Since 1951, there has been a progressive decrease in the size of adults of *G. swynnertoni* in the area studied, more especially in those produced in the dry season.

Sawicki (R. M.). **A technique for the topical application of poisons to non-anaesthetised house-flies for knockdown assessments.**—*Bull. ent. Res.* **51** pt. 4 pp. 715–722, 2 figs., 11 refs. London, 1961.

When knockdown is assessed by a spraying technique, the amount of insecticide picked up by the flying insects is very variable, and it has been impracticable to use topical application, because the only effective method of immobilising the insects without anaesthetising or cooling them, which affect response to insecticides, was by suction involving individual handling, which was too laborious and time consuming. In this paper, a description is given of an apparatus and technique by means of which batches of 8 to 10 house-flies (*Musca domestica* L.) are rapidly immobilised by suction and each fly dosed individually. The apparatus consists of a specially designed cage, a suction platform (essentially a circular pad of terylene gauze) connected to a vacuum cleaner, and a measured-drop apparatus. Flies of known age are drawn from the cage on to the pad, the males are discarded and the females are held there by suction while they are treated. The cage can be made to contract, so that the flies may be crowded together near the special emergence hole through which they are to be withdrawn. The time taken to handle a batch of ten flies is about three minutes and to treat them, ten seconds.

The flies are not seriously affected by the suction, but randomisation is not entirely satisfactory as the most active females tend to reach the pad first. The greatest chance of error was thought to lie in the possibility that part of the insecticide applied to the insect might be removed by the flow of air during treatment, but it was found that although fluid sometimes spread to the pad when the air flow regulator was fully closed, it did not do so if the regulator was opened enough to allow the fly to lift the head and thorax slightly from the gauze, while remaining attached to it by the wings and abdomen. Two experiments are described to illustrate the consistency of the results. Although particularly suitable for the measurement of knockdown, as it immobilises highly active insects without apparently damaging them or affecting their metabolism, the technique can be used equally well to estimate toxicity.

Whitehead (G. B.) & Baker (J. A. F.). **Acaricide resistance in the red tick, *Rhipicephalus evertsi* Neumann.**—*Bull. ent. Res.* **51** pt. 4 pp. 755–764, 6 graphs, 5 refs. London, 1961.

Early in 1959, observations on the farm Tayside, in the East London district of South Africa, suggested that dips of 0·25 per cent. toxaphene were not controlling populations of *Rhipicephalus evertsi* Neum. on stock so well as they had formerly done. The chemicals that had been used at Tayside for tick control up to that time were sodium arsenite from 1920 to 1945, BHC from 1946 to 1948, DDT from 1949 to 1955 and toxaphene from 1955 to 1959. Resistance to toxaphene was suspected, and investigated in both field and laboratory experiments. In the field, hand spraying of infested cattle with 0·25 per cent. toxaphene had little effect, and, though 0·5 per cent. gave some control of larvae, nymphs and adults, it was considerably less effective than would have been expected from previous experience. A comparative hand-dressing trial with several insecticides at Tayside and at Riverdale (where 0·25 per cent. toxaphene was still effective) indicated an increased tolerance in the Tayside population of the tick to toxaphene, γ BHC and dieldrin, but not to sodium arsenite or DDT. Similar results were obtained in the laboratory, where fully engorged Tayside females were compared by an immersion technique [*R.A.E.*, B **36** 21] with females from Riverdale. The former were appreciably resistant to toxaphene, γ BHC and dieldrin but not to sodium arsenite or Delnav (2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)). Laboratory experiments by a modification of the immersion technique [**47** 23], with larvae bred from fully engorged adults, indicated a high degree of resistance to toxaphene and γ BHC in the Tayside population, but no unusual tolerance of Delnav, Sevin or DDT. To test susceptibility to sodium-arsenite solutions, batches of about 50 larvae were put between sheets of filter paper, the edges of which were crimped between a set of meshing cogs to form a saucer-shaped cell. This cell was put on a glass plate, concave surface uppermost, treated from a pipette with 0·5 ml. solution and covered with the lid of a petri dish. Mortality counts were made after storage for 72 hours. Results from tests with solutions of sodium arsenite showed no resistance in larvae from Tayside. A similar pattern of cross-resistance has been found in *Boophilus decoloratus* (Koch) in South Africa.

Glasgow (J. P.). **The variability of fly-round catches in field studies of *Glossina*.**—*Bull. ent. Res.* **51** pt. 4 pp. 781–788, 2 figs., 9 refs. London, 1961.

The following is based on the author's summary. Three fly-rounds at Shinyanga, Tanganyika, were carried out every weekday for four weeks, in an attempt to assess the errors to which this method of studying populations of *Glossina* is subject. The species studied was *G. swynnertoni* Aust. One of the rounds was a transect fly-round [*R.A.E.*, B **47** 151], the others were of the older type, divided into a few long sections according to the vegetation. The catches showed no obvious trend during the experiment, which suggested that the true population had not altered in the period, but there were considerable day-to-day variations in catch in all three rounds and, in this respect, the transect fly-round did not differ from those carried out by the older method though its other advantages [*cf. loc. cit.*] remain unchallenged. Analysis of the data from the transect fly-round showed that the variance between days was greater than could be accounted for by random errors. Separate consideration of the data collected on certain days of the week showed that a smaller than five-fold change in the mean catch could not be detected by carrying out a 7,500-yard fly-round once a week. To detect a two-fold change, it would be necessary to carry out a 15,000-yard fly-round twice a week. The relation between fly-round catch and true density is discussed; this relation is usually termed availability [*cf.* **44** 116], and earlier workers have shown that its mean value, over periods of about one month, is not necessarily constant; the present work shows that it varies in one place from day to day.

Brown (A. W. A.), McKinley (D. J.), Bedford (H. W.) & Qutubuddin (M.). **Insecticidal operations against Chironomid midges along the Blue Nile.**—*Bull. ent. Res.* **51** pt. 4 pp. 789–801, 6 figs., 6 refs. London, 1961.

The following is virtually the authors' summary. In 1956 and 1957, in the Sudan Republic, four methods of applying insecticides were tested for the control of heavy infestations of midges, particularly *Tanytarsus lewisi* Freeman, that breed in the Blue Nile. During the winter, the adults occur in myriads in areas adjacent to the river in Khartoum and similar localities, resting in trees and shrubs by day and being attracted to artificial lights after dusk [*cf. R.A.E.*, B **45** 93, etc.]. An emulsion containing 0·4 per cent. DDT applied from the ground to shade-trees in Khartoum at the rate of 0·5–1 lb. DDT per tree achieved local control of the midges for three days and detectable reduction for ten days. An emulsion containing 12·5 per cent. DDT applied from an aircraft to the wooded river-frontage at Khartoum at 2·1 lb. per acre reduced the numbers of adult midges for the next 15 days, but subsequent applications under conditions of greater air turbulence were ineffective.

The application of DDT as a larvicide in oil solution from aircraft to the river ten miles above Khartoum, at a concentration approximately equivalent to 0·1 part per million in two hours' river flow, did not appear to reduce the numbers of adults or immature stages at Khartoum, and was followed by some mortality of fish. The application of 500 lb. DDD as a larvicide in 500 gal. of a wettable-powder suspension sprayed from aircraft on 6th–7th November 1957 to three sections, each three miles long, of the Blue Nile reservoir in a 30-mile stretch upstream of the Sennar dam, 150 miles above Khartoum and 60 miles above Wad Medani, was followed by exceptionally low densities of larvae and adults at Sennar in early 1958 and at Wad Medani and Khartoum in early 1959.

Loomis (E. C.) & Green (D. H.). **Ecological observations on *Culex tarsalis* Coquillett and other mosquitoes in the Delta region of the Central Valley of California, 1953–1956 (Diptera: Culicidae).**—*Ann. ent. Soc. Amer.* **52** no. 5 pp. 524–533, 5 graphs, 22 refs. Washington, D.C., 1959.

Investigations were made in the San Joaquin Valley of California in 1953–56 on populations of *Culex tarsalis* Coq. and other mosquitos in artificial and natural resting places and on three methods of measuring those in the former. The following is based on the authors' summary of the work.

Evidence of blood-meals and ovarial development in *C. tarsalis* was more apparent in February–March than during the normal overwintering period (November–January). Males were ordinarily first found in early April, following the appearance of larvae in March in rain and irrigation water. *C. tarsalis* showed a greater preference for natural resting places (animal burrows and tree stumps) over artificial ones (chicken houses, cellars and bridges) than did other species of the genus. The population reached peaks in June, July or August in the artificial resting places and in August or September in the natural ones, and light-trap collections were greatest in July or August. For measuring populations in artificial resting places, cardboard boxes 1 cu. ft. in size [*cf. R.A.E.*, B **48** 220] proved as reliable as 10-minute collections and 5-minute estimates. Less detailed observations on the other species are presented.

Mulla (M. S.) & March (R. B.). **Flight range, dispersal patterns and population density of the eye gnat,** *Hippelates collusor.—Ann. ent. Soc. Amer.* **52** no. 6 pp. 641–646, 2 figs., 5 refs. Washington, D.C., 1959.

Species of *Hippelates* are a nuisance in the Coachella Valley, southern California, alighting on the face, mucous membranes and other exposed parts of man and domestic animals. *H. collusor* (Tns.) is the predominant species in the south-west [*cf. R.A.E.*, B **41** 87], and an important consideration in organising control measures is the distance to which the adults can fly. This was investigated in 1957, and the following is based on the authors' abstract of this account of the work.

Batches of over 30,000 adults labelled with ^{32}P administered in their food were released in the Palm Desert and Indio areas of the valley. The gnats generally dispersed into agricultural areas and adjacent residential sections where conditions were favourable for feeding and breeding. They avoided virgin desert and barren hills, but crossed half a mile of desert to suitable habitats on the far side. Dispersal occurred both upwind and downwind, but the greatest distances travelled in each experiment (4·1 and 4·3 miles) were with the wind. In one experiment, the population density of the insects trapped was estimated at 3,000–5,000 per acre. The gnats were found resting at night on dry or damp ground, on soil clods, on dried rootlets protruding above the ground, and on the foliage of low-growing plants.

Lewallen (L. L.) & Nicholson (L. M.). **Malathion metabolism in larvae of resistant mosquito strains.**—*Ann. ent. Soc. Amer.* **52** no. 6 p. 767, 5 refs. Washington, D.C., 1959.

In the test described, fourth-instar larvae of a malathion-resistant strain of *Culex tarsalis* Coq. from Fresno County, California [*cf. R.A.E.*, B **47** 198], and larvae of a susceptible laboratory strain were exposed for 30 minutes at 70°F. to 100 ml. water to which 1 ml. of a 1 per cent. w/v acetone solution of malathion was added. The larvae were then washed and ground, and extracts from them tested for malathion and malaoxon (to which malathion is metabolised in many insects and vertebrates) by a paper-chromatographic method. Unchanged malathion was not detected in either strain, but a compound corresponding to malaoxon was found in both, indicating that conversion of malathion was similar. So far, no explanation for the resistance was apparent.

RAFFAELE (G.), COLUZZI (A.) & DE ZULUETA (J.). **Observations on the effect of numbers and age on the susceptibility of mosquitos to DDT.**—*Bull. World Hlth Org.* **18** no. 3 pp. 464–468, 9 refs. Geneva, 1958.

The importance of the age of the mosquitos used in tests of susceptibility to insecticides was examined in experiments made with blood-fed females from laboratory strains of *Anopheles labranchiae atroparvus* van. Thiel, *A. stephensi* List. and *Aëdes aegypti* (L.) and the importance of numbers was examined in experiments with the first. Exposure was in artificial light, but the mosquitos were subsequently kept in darkness. For the tests of age, females were caught individually in small vials, exposed singly for an hour in chambers measuring 3 × 1 in. and lined with filter paper impregnated with DDT and were finally transferred for a 24-hour observation period to vials measuring 2 × 1 in. and provided with a piece of moist blotting-paper and stoppered with a cork. The percentages of females of *Anopheles stephensi*, *A. l. atroparvus* and *Aëdes aegypti* more than 30 and (in brackets) 4–6 days old killed by deposits of DDT from a 2 per cent. xylene solution were 90 (36), 45 (8) and 46 (10), respectively. When adults of *Anopheles l. atroparvus* more than 30 and (in brackets) 3–5 days old were similarly exposed to papers impregnated with 1, 2 and 4 per cent. DDT in Risella oil by Busvine's technique [*R.A.E.*, B **41** 156], percentage mortalities were 7·5 (0), 15 (0), and 27·5 (10), respectively. Busvine's complete method [*loc. cit.*] was used in tests of the effect of numbers on the susceptibility of females of *A. l. atroparvus* of fairly uniform age to DDT in Risella oil. After exposure, the mosquitos were kept in carton cups, and varying the number per cup from five to 20 made no difference to mortality. Percentage mortalities caused by 0·5, 1, 2 and 4 per cent. DDT were 8·8, 5, 5 and 15 when there was one mosquito per exposure vial, 5, 3·3, 5 and 2·5 when there were two and 6, 0, 2·1 and 22·8 when there were five. It is concluded that the increase in activity occasioned by the presence of five individuals in a confined space (a 3 × 1 in. vial) increases the amount of insecticide picked up and the amount of damage suffered from collisions and so increases mortality.

KELLEN (W. R.) & LIPA (J. J.). *Thelohania californica* **n. sp., a Microsporidian parasite of** *Culex tarsalis* **Coquillett.**—*J. Insect Path.* **2** no. 1 pp. 1–12, 32 figs., 8 refs. New York, N.Y., 1960.

The following is based on the authors' summary. *Thelohania californica*, sp. n., is described from larvae of *Culex tarsalis* Coq. in California. The Microsporidia invade the adipose tissue and are highly pathogenic, less than 2 per cent. of the infected larvae observed in the laboratory giving rise to adults. Limited field sampling indicated that 5–25 per cent. of the larvae are infected in nature. Preliminary attempts, some of which were successful, to transmit the disease to healthy larvae in the laboratory are described.

DUNN (P. H.). **Control of house flies in bovine feces by a feed additive containing** *Bacillus thuringiensis* **var.** *thuringiensis* **Berliner.**—*J. Insect Path.* **2** no. 1 pp. 13–16, 2 refs. New York, N.Y., 1960.

The following is virtually the author's summary. Laboratory studies showed that cattle given *Bacillus thuringiensis* var. *thuringiensis* as an additive in their feed produced faeces that inhibited the development of 92 per cent. of larvae of *Musca domestica* L. reared in them from their second day of life. Most of the mortality occurred in the pupal and not the larval stage. Faeces from control animals allowed development of all but 19 per cent. of the larvae. It is suggested that mortality is due to a toxic effect perhaps caused by the protein crystals associated with the bacteria [*cf. R.A.E.*, B **49** 3].

Pavilanis (V.) & Rozewicz (M.). **Culture de** *Coxiella burneti* **chez le pou. Isolement de** *Coxiella burneti* **des produits pathologiques par l'inoculation aux poux.**—*Rev. canad. Biol.* **17** no. 4 pp. 503–511, 3 figs., 16 refs. Montreal, 1958. (With a summary in English.)

As it has been shown that *Coxiella burneti*, the causal agent of Q fever, can survive and multiply in body lice, *Pediculus humanus humanus* L. (*P. vestimenti* Nitzsch), into which it has been introduced by inoculation into the body cavity or rectum [*R.A.E.*, B **43** 76], a study was made of the practicability of using the louse for the isolation of *C. burneti* from infected material. It was found comparatively easy to keep a colony of lice under aseptic conditions in cages sterilised by weekly autoclaving. Blood-meals on a human volunteer were normally given daily. Lice could also be reared on rabbit, provided that they had had an initial feed on man soon after hatching, but mortality was higher than among those fed on man throughout. Rickettsiae could be detected in the body fluid 6–12 days after injection of material into the body cavity, whereas at least 30 days are needed for the detection of antibodies when guineapigs or mice are used. Intrarectal injection showed that the gut was a less favourable site of multiplication for the rickettsiae. The lice were unaffected by the presence of the latter and provide as sensitive a means of detecting their presence as do guineapigs. Lice fed on a rabbit with *C. burneti* in its blood became infected, and the rickettsiae appeared in the excreta from the fourth day. It is concluded that the louse could transmit Q fever.

Bergmann (E. D.), Levinson (Z. H.) & Mechoulam (R.). **The toxicity of** *Veratrum* **and** *Solanum* **alkaloids to housefly larvae.**—*J. Insect Physiol.* **2** no. 3 pp. 162–177, 1 fig., 38 refs. London, 1958.

The toxic effects on insects of alkaloids extracted from *Solanum* and species of *Veratrum*, among which the author includes sabadilla, have been known for some time [*cf. R.A.E.*, A **29** 352; **34** 301; B **33** 65; **34** 163], and an account is given of investigations on the toxicity of such extracts when administered in their food to larvae of *Musca domestica vicina* Macq. and their effects on development. The following is substantially the authors' abstract of the results. The toxicity of an extract of *V. album*, administered in their food, diminished with increasing age of the larvae and disappeared in the third instar. Initial retardation of growth was proportional to the concentration of the poison. The benzene-insoluble fraction of *V. album* was largely non-toxic, whereas the benzene-soluble fraction contained highly toxic ester alkaloids, which were also tested in pure form. The active compounds acted as stomach poisons. The toxicity of the ester alkaloids of *Veratrum* was dependent on the intactness of their molecules, their constituent alkamines being non-toxic. The more ester groups the alkaloid contained, the more toxic it was. Larval resistance to *V. album* developed relatively slowly over a series of generations exposed to it in the diet. The glycosidic alkaloids of *Veratrum* and *Solanum* were practically non-toxic for fly larvae. The toxic action of protoveratrine on house-fly larvae was not due to an antagonism to cholesterol.

BEAMENT (J. W. L.). **A paralysing agent in the blood of cockroaches.**—*J. Insect Physiol.* **2** no. 3 pp. 199–214, 2 figs., 7 refs. London, 1958.

The following is based on the author's abstract. Nymphs of *Periplaneta americana* (L.) were affected by a form of paralysis during, or after long periods of, immobilisation by pinioning. Similar physiological states were produced by excessive mechanical or electrical stimulation. Experiments with parabiotic pairs, in which an incompletely immobilised cockroach was attached to one completely immobilised in such a way that their blood systems were united, and other experiments in which blood from a paralysed cockroach was injected into a normal one suggested that paralysis is caused by a blood-borne agent, and a parallel is drawn between the hyper-activity of the nervous system preceding paralysis brought about through the insect's own struggles and that preceding paralysis brought about by direct stimulation or by DDT [*cf. R.A.E.*, B **49** 30].

GIANNOTTI (O.). **Estudos sôbre o mecanismo de ação do aldrin, dieldrin, isodrin e endrin em** *Periplaneta americana* **(L.).** [Studies on the mechanism of action of aldrin, dieldrin, isodrin and endrin in *P. americana.*]—*Arch. Inst. biol.* **25** (1958) pp. 253–259, 5 refs. São Paulo [1959]. (With a summary in English.)

The following is based on the author's summary. Further experiments are described showing not only that aldrin is converted to dieldrin in *Periplaneta americana* (L.) [*R.A.E.*, B **46** 115], but also that isodrin is similarly converted to endrin. Conversion takes place mainly in the gut. A fraction of unknown nature, apparently less toxic to mosquito larvae than isodrin or endrin, was found in addition to endrin in cockroaches treated with isodrin; chromatographically, it resembled an impurity found in technical endrin.

ASCHER (K. R. S.). **Aufsuchung der " durch Resistenz induzierten, erhöhten Empfindlichkeit "—eine neue Versuchsrichtung zur Bekämpfung der Resistenz gegen Insekticide.** [Location of resistance-induced, enhanced susceptibility—a new method of research in the control of resistance to insecticides.]—*Arzneim.-Forsch.* **8** pp. 771–773, 30 refs. Aulendorf i. Württ., 1958. (With a summary in English.)

The following is based on the author's summary. A new experimental method for research on the control of insects that have become resistant to insecticides is described. It consists in the endeavour to locate 'resistance-induced enhanced susceptibility' to specific agents in the resistant insect. The method is illustrated by the results obtained with DDT-resistant house-flies [*Musca domestica* L.] and compounds containing the bromide ion [*R.A.E.*, B **44** 15] and tarsal contact poisons of the bromoacetate series, especially cetyl bromoacetate [**48** 58].

MATHIS (W.) & SCHOOF (H. F.). **Organophosphorus compounds as residual treatments for adult mosquito control.**—*Amer. J. trop. Med. Hyg.* **8** no. 1 pp. 1–4, 1 ref. Baltimore, Md., 1959.

After preliminary laboratory tests, the effectiveness of various organophosphorus compounds as deposit sprays against adults of *Anopheles quadrimaculatus* Say was investigated under simulated field conditions in Georgia in 1956 and 1957. In 1956, two huts were constructed with an opening under the roof overhang through which wild mosquitos could enter, and screen traps were placed over the two windows to capture mosquitos leaving the hut. Removable plywood panels inside one of the huts were sprayed with wettable malathion at the rate of 100 mg. per sq. ft., and rabbits served as an attractant and source of blood. Weekly evaluations were made by collecting wild mosquitos from the interior of the huts and from the window traps, for five weeks after treatment, but after this time the numbers of mosquitos entering were insufficient for satisfactory tests, and 100 laboratory-reared females of *A. quadrimaculatus* were released in each hut, at weekly intervals, and left for one hour, after which they were recovered, provided with honey solution and observed for mortality after 24 hours. All the wild examples of *A. quadrimaculatus* collected within the treated hut and 65–100 per cent. of those caught in the window traps were dead. The malathion did not apparently repel the mosquitos, as more were recovered in the treated than in the untreated hut, and the percentages of females that fed were about the same in both; only two of the blood-fed mosquitos from the treated hut survived for 24 hours after exposure. The 24-hour mortalities of the laboratory-reared females, exposed 7, 8, 9, 10 and 13 weeks after treatment of the panels, were 100, 98, 100, 70 and 36 per cent., respectively.

In the 1957 tests, laboratory-reared females were exposed in huts similar to those used in 1956, but with an entrance cage attached to each at window level. The removable plywood panels were sprayed with DDT at 200 mg. per sq. ft., alone or with 25 mg. EPN, with malathion at 100 or 200 mg., alone or with 200 and 100 mg. DDT, respectively, with dieldrin at 25 or 50 mg., alone or with 100 mg. malathion, or with parathion at 12·5 mg., alone or with 200 mg. DDT. Panels treated with some of the higher dosages were stored for ageing. In each test, one hut was left untreated, and after it, the panels were removed and stored. A rabbit was put in each hut in the evening, mosquitos were placed in the entrance cage, and in the morning, dead and living mosquitos were collected from the hut and window traps, and those living were kept for a 24-hour mortality count. In each test, about 50–150 three-day-old laboratory-reared females of a dieldrin-resistant strain obtained from Mississippi and of a susceptible strain of *A. quadrimaculatus* were used. Each insecticide formulation was tested against the dieldrin-resistant strain at fortnightly intervals from June to October, and against the susceptible strain as time permitted. All formulations containing malathion or parathion alone or with DDT or dieldrin gave 100 per cent. mortality of dieldrin-resistant mosquitos for the 11–20 weeks of the test. The mixture of DDT with EPN, which was not evaluated during the first four weeks after treatment, killed, in the next 12 weeks, 98–100 per cent. of the mosquitos recovered in the huts, and 27–100 per cent. of those from the window traps. Dieldrin gave mortalities of 40–75 per cent., and DDT, tested two, three, four and five months after treatment, killed 30, 26, 54 and 54 per cent., respectively. All formulations, except DDT alone, gave 100 per cent. mortality of susceptible mosquitos. Dieldrin-resistant and susceptible mosquitos entered the untreated huts in similar numbers, but 42 per cent. of the resistant individuals were caught in the exit traps as compared with 12 per cent. of the susceptible ones.

Furman (D. P.). **Feeding habits of symbiotic Mesostigmatid mites of mammals in relation to pathogen-vector potentials.**—*Amer. J. trop. Med. Hyg.* **8** no. 1 pp. 5–12, 11 refs. Baltimore, Md., 1959.

Feeding tests were carried out in California with *Haemogamasus liponyssoides* Ewing from the nests and bodies of *Microtus californicus*, *H. oudemansi* Hirst, *H. ambulans* (Thorell) and *Haemolaelaps glasgowi* (Ewing) [*cf. R.A.E.*, B **47** 33] from nests of *Neotoma fuscipes*, *Laelaps* (*Echinolaelaps*) *echidninus* Berl. and *Ornithonyssus bacoti* (Hirst) from *Rattus norvegicus*, and *Brevisterna utahensis* (Ewing) from nests of *N. lepida* and *N. fuscipes*, to assess their potentialities as vectors of pathogenic organisms. The mites were maintained in small culture tubes on heparinised mouse blood supplied daily on a cotton plug. For feeding trials, the open end of a vial containing up to 10 mites was applied to the intact skin of various adult rodents for 20–90 minutes, or to skin that had been scraped until serous exudate or blood appeared. Feeding and culture trials were also carried out by keeping unrestrained mites in boxes containing suckling mice, damp cotton balls and moist autoclaved *Microtus* nest material. Other materials tested as food were dried mouse blood, the excreta of *Xenopsylla cheopis* (Roths.) and the waste food, faeces and urine of host rodents. The predacious tendencies of the mites were investigated by placing arthropods or arthropod parts in tubes with them.

Haemogamasus ambulans fed on living or dead arthropods, dried blood, flea excreta and blood or tissue fluids of vertebrates, and was able to live and reproduce on a diet composed solely of arthropods or dried blood; it did not penetrate the skin of adult rodents or man, and only rarely that of suckling mice; it refused to feed on mouse faeces, urine, sugar solution or decaying plant material, nor were any mites observed to feed when provided with waste food, faeces and urine of *Microtus*. *L. echidninus* and *Haemolaelaps glasgowi* were general feeders, but the latter proved capable of rasping delicate vertebrate skin until tissue fluids were available. In limited tests, *B. utahensis* did not penetrate intact skin but fed readily on either dried or fluid blood. *Haemogamasus oudemansi* fed on free, liquid blood but did not penetrate skin or feed on dry blood. *H. liponyssoides* appeared to be an obligatory blood feeder, as it penetrated intact host skin and engorged on blood, and would not feed on dry blood or on small arthropods. *O. bacoti*, serving as a control, pierced the host skin and fed on blood.

Aitken (T. H. G.). **Virus transmission studies with Trinidadian mosquitoes.** —*W. Ind. med. J.* **6** no. 4 pp. 229–232. Kingston, Jamaica, 1957.

Aitken (T. H. G.) & Anderson (C. R.). **Virus transmission studies with Trinidadian mosquitoes. Part II. Further observations.**—*Amer. J. trop. Med. Hyg.* **8** no. 1 pp. 41–45, 12 refs. Baltimore, Md., 1959.

From 1953 to 1956, 71 strains of virus were isolated in Trinidad from wild mosquitos, comprising 22 of yellow fever [*R.A.E.*, B **45** 101], seven of Ilhéus encephalitis [*cf.* **46** 159], three of St. Louis encephalitis [**47** 158], and 39 that were not identified, and preliminary attempts to propagate three viruses in local mosquitos and to effect transmission by bite are described in the first paper. Females of *Aëdes serratus* (Theo.) and *Psorophora ferox* (Humb.) collected in the forest were allowed to feed on infant mice that had been inoculated with a Brazilian strain of Ilhéus virus 3–4 days before. Virus was recovered after 14, 15 and 24 days from *Aëdes* and after 15, 16, and 29 days from *Psorophora*, but transmission was not effected when mosquitos were given access to susceptible infant mice 12–14, 22 and (one mosquito) 26 days after their infecting feed; this was not surprising, since a very low level of virus was circulating in the mice when the mosquitos were exposed for their first infective meal. Adult forest mosquitos were infected with Mayaro virus [**48** 90] by puncturing the thorax with a capillary tube or steel needle dipped in virus suspension. After incubation periods of 5–12 days, virus was recovered from females of *A. scapularis* (Rond.), *A. serratus*, *Culex pipiens fatigans* Wied., *Mansonia arribalzagae* (Theo.), *M. venezuelensis* (Theo.), *M. wilsoni* (Barreto & Coutinho) and *P. ferox*. Of ten attempts to transmit the virus to day-old chicks by bite, only one was successful, the virus being recovered three and four days after the chick had been exposed to three infected females of *A. scapularis*. Six attempts to transmit Mayaro virus by *C. p. fatigans* failed. *C. p. fatigans*, *M. arribalzagae*, *M. venezuelensis*, *P. ferox* and *Trichoprosopon digitatum* (Rond.) were infected with a local strain of St. Louis virus by puncturing the thorax, and the incubation periods were 7–19 days. All these species except the last transmitted the virus to day-old chicks after incubation periods of 7–10 days, and *C. p. fatigans* transmitted it after 11 days to a mouse two days old.

Further experiments on the transmission of these three viruses by Trinidad mosquitos are described in detail in the second paper. The strains used were one of Ilhéus virus isolated originally from a mixed pool of mosquitos [**46** 159], one of St. Louis virus from *P. ferox* [**47** 158], and one of Mayaro virus from a forest worker [**48** 90]. The mosquitos used were *Aëdes scapularis*, *A. serratus*, *M. arribalzagae*, *M. venezuelensis*, *M. wilsoni*, *P. albipes* (Theo.) and *P. ferox* caught as adults in the forest, *C. p. fatigans* (*quinquefasciatus*, auct.) and *A. aegypti* (L.) from laboratory cultures, and *T. digitatum* reared from larvae collected in the field. The thorax of the mosquitos was punctured with a needle or glass capillary tube previously dipped in virus suspension, which was immediately afterwards titrated in mice. Suspensions made from triturated mosquitos after they had been maintained for varying periods in cages provided with sugar solutions were injected into mice, and brain suspensions from mice that became sick were injected intracerebrally into fresh mice until a typical infection resulted, and the identity of this was tested with normal and immune sera. Also, infected mosquitos were allowed to bite chicks 1–2 days old and mice two days old; brains of the sick mice were passaged as above, and specific identity tests carried out with the sera of the chicks and the brains of the mice. Circulating virus in chicks was demonstrated by injecting their blood, removed at intervals of 3–4 days, diluted and centrifuged, into mice. The serum of any chicks that survived one month was tested for specific antibody by the neutralisation test.

Transmission of Ilhéus virus was effected by *A. aegypti*, *A. scapularis*, *A. serratus*, *C. p. fatigans*, *P. albipes* and *P. ferox*, all the species tested, after incubation periods of 6–14 days, single individuals or groups of 2–8 mosquitos having been used. In several instances, specific antibodies were not demonstrated in the chicks. St. Louis virus was transmitted by the bites of single individuals of *A. aegypti*, *C. p. fatigans*, *M. arribalzagae*, *M. venezuelensis* and *P. ferox* and of three individuals of *A. serratus*. Antibodies were demonstrated in all chicks that survived one month and in the blood of which virus had been found. The virus was recovered from three females of *T. digitatum* 7, 9 and 11 days after injection, but this species failed to feed on chicks. Mayaro virus was transmitted by the bite of a single individual of *A. scapularis* after an incubation period of 7 days, and neutralising antibodies were demonstrated in convalescent serum. Of six other species that harboured the virus for at least 12 days, only *A. serratus*, *C. p. fatigans* and *M. wilsoni* survived long enough to be used in biting experiments, and none effected transmission.

AITKEN (T. H. G.), DOWNS (W. G.) & ANDERSON (C. R.). **Parasitic *Philornis* flies as possible sources of arbor virus infections (Diptera, Anthomyidae).**—*Proc. Soc. exp. Biol.* **99** pp. 635–637, 2 refs. New York, N.Y., 1958.

The following is based on the authors' summary of observations in Trinidad in 1957–58. Anthomyiids of the genus *Philornis* that attack nestling birds were shown to be able to become infected with the virus of St. Louis encephalitis and Ilhéus virus. In one instance, a larva was found positive for St. Louis virus after feeding on a nestling ani (*Crotophaga ani*) that was circulating that virus. In another, two out of eight adult flies were found to be infected with Ilhéus virus after inoculation as larvae 10 and 11 days previously, one pupa examined being negative. Similarly, six out of eight adults proved positive for St. Louis virus after inoculation ten days previously as larvae. Both viruses had multiplied in the flies.

MAEVSKIĬ (A. G.). **The results of six years' phenological observations on the malaria mosquito, *Anopheles maculipennis* Mg. (Diptera, Culicidae), in the northern districts of White Russia.** [*In Russian.*]—*Rev. Ent. URSS* **37** pt. 3 pp. 630–640, 1 graph, 5 refs. Moscow, 1958.

Observations near Polotsk, in White Russia, in 1948–53 showed that the females of *Anopheles maculipennis* Mg. left their winter quarters mainly in the second and third ten days of April. Those that had overwintered in warm conditions emerged earlier, however, and fed before the mass emergence, but digestion and egg development, which depend on temperature, were delayed. There were 3–4 generations during the year. The mass flight to winter quarters took place from August or September to October, and females that were not fully fed and were trapped by cold in day-time shelters did not survive. Blood-feeding generally ceased in September, though some individuals fed until November, and females with developed ovaries appeared until October. The last males were observed in mid-October.

The eggs were laid in stretches of standing water, and were most abundant in the shallower, warmer parts. The first larvae appeared at the beginning of May, and development lasted 28 days. Eggs were observed until the beginning of October, but larvae were not present in large numbers after September, although they could withstand limited freezing and consequently survived longer in larger patches of water.

In view of these findings, it is recommended that DDT or BHC should be applied to day-time resting places about 10th May and that treatment of breeding places should be begun about 20th May and continued at monthly intervals until August. Where cases of malaria occur, thorough house-spraying throughout the community should be practised.

LU (Siu-chin), MA (Teh-chi) & LEE (Chin-peh). **The blood preference of some Culicine mosquitoes in rural areas of Nanking.** [*In Chinese.*]—*Acta ent. sin.* **9** no. 2 pp. 178–182, 14 refs. [Peking] 1959. (With a summary in English.)

Replete mosquitos were collected from various resting places near Nanking in May–October 1955, and the sources of their blood-meals investigated by means of precipitin tests. Of 1,155 females of *Culex pipiens pallens* Coq., 92 per cent. had fed on human blood and a negligible number on domestic animals or fowls. Of 2,016 of *C. tritaeniorhynchus* Giles, 46·3 and 43·5 per cent. contained the blood of cows and horses, respectively, and 8·6 per cent. human blood. *Armigeres obturbans* (Wlk.) preferred cow blood to human blood.

Tung (Bing). **Preliminary observation on the hibernation of** *Culex pipiens pallens* **in Tsinan.** [*In Chinese.*]—*Acta ent. sin.* **9** no. 2 pp. 190–194, 1 fig., 4 refs. [Peking] 1959. (With a summary in English.)

Observations in Tsinan showed that *Culex pipiens pallens* Coq. hibernates from about November to late February, depending on temperature, chiefly in cellars, hollows and caves. All the hibernating forms seen were females.

Ascher (K. R. S.). **The attraction of the Levant housefly** *Musca vicina* **Macq. to natural breeding media.**—*Acta trop.* **15** no. 1 pp. 1–14, 2 figs., 25 refs. Basle, 1958. (With summaries in French & German.)

Studies carried out in connection with investigations on the rural breeding sites of *Musca domestica vicina* Macq. in Israel showed that the dung most attractive to adults, including the males, was that of the pig. A solution of ammonium carbonate also attracted both sexes, but a 5 per cent. solution of yeast was attractive for the females only.

Aeschlimann (A.). **Développement embryonnaire d'***Ornithodorus moubata* **(Murray) et transmission transovarienne de** *Borrelia duttoni.*—*Acta trop.* **15** no. 1 pp. 15–64, 24 figs., 46 refs. Basle, 1958. (With summaries in English & German.)

Wagner-Jevseenko (O.). **Fortpflanzung bei** *Ornithodorus moubata* **und genitale Übertragung von** *Borrelia duttoni.* [Reproduction in *O. moubata* and genital transmission of *B. duttoni.*]—*T. c.* no. 2 pp. 118–168, 2 col. pls., 15 figs., 50 refs. (With summaries in French & English.)

Ornithodoros moubata (Murr.) transmits *Borrelia duttoni* to its progeny through the egg, but the mechanism of the transfer was not understood. The author of the first paper investigated and describes the embryogenesis of the tick, and shows that the spirochaetes penetrate from the haemolymph of the female into the germinative tissue of the ovary, form clusters and invade the oöcytes. They penetrate the latter only before the membrane is formed, and mature eggs cannot be infected. The spirochaetes enter the nervous system of the developing embryo, but do not reach the salivary glands until the larvae have hatched.

The author of the second paper describes the processes of spermatogenesis and oögenesis in *O. moubata* and shows that, although *B. duttoni* accumulates in the testicular walls, it rarely enters the spermatophores, so that transmission from males to females during pairing is of very infrequent occurrence.

Garnham (P. C. C.) & Lewis (D. J.). **Parasites of British Honduras with special reference to leishmaniasis.**—*Trans. R. Soc. trop. Med. Hyg.* **53** no. 1 pp. 12–35, 2 pls., 13 figs., 56 refs. London, 1959.

A six-week survey of the incidence of cutaneous leishmaniasis in British Honduras and of the species of *Phlebotomus* that bite man there and may be responsible for transmission was carried out in 1958. The disease is prevalent chiefly among the collectors of sapodilla latex, used to make chewing gum, who spend the whole six months of the rainy season in the forest. It appeared to be negligible among plantation workers and others who did not spend long periods in the forest itself. Most of the cases seen were of the chronic type (of more than 12 months' duration). The causal organism could be found only in the newest; it, and its behaviour in laboratory animals, are described. The organism is provisionally treated as a clinical variety of *Leishmania brasiliensis*. In view of its rarity in old lesions and the small number of people in the forest, it is thought that infection must be maintained in wild animals, but none was found in small wild rodents (including *Ototylomys guatemalae*, *Oryzomys couesi*, *Sigmodon hispidus* and *Rattus rattus*), paca (*Cuniculus paca nelsoni*), armadillo (*Dasypus novemcinctus*), opossums (*Didelphis mesamericana tabascensis* and *Metachirops opossum pallidus*), and a fox, or in dogs of two forest villages.

In a survey of *Phlebotomus* designed to ascertain the species present, to obtain males for confirmation of the identity of certain species, to show which species bite man, and to investigate resting sites, collections were made from human bait and by various other means. These yielded 14 species, eight of them on man. The latter were *P. cruciatus* Coq., which is believed to transmit cutaneous leishmaniasis in Mexico, two species (*P. apicalis* Floch & Abonnenc and *P. ylephiletor* Fairchild & Hertig) closely related to *P. whitmani* Antunes & Coutinho, a vector in Brazil, *P. panamensis* Shannon, a suggested vector in Venezuela, and *P. bispinosus* Fairchild & Hertig, *P. geniculatus* Mangabeira, *P. shannoni* Dyar and *P. ovallesi* Ortiz. Brief notes are given on their habits and distribution. Like leishmaniasis, they were found almost exclusively in forest and were quite numerous. They were never found indoors. Individuals of five of them were taken in day-time resting places, but only *P. panamensis* was common in these. This species occurred in rather open forest and *P. ylephiletor* among tall trees. *P. panamensis*, *P. ylephiletor*, *P. shannoni* and *P. cruciatus* together made up 84 per cent. of the total taken on man. No leptomonads were found in the small number of *Phlebotomus* dissected. Neither control of the vectors nor the use of repellents against them appears to be practicable.

Notes on incidental observations on invertebrates of other groups include data on Simuliids already noticed from a fuller source [*R.A.E.*, B **48** 75–76] and records of various mosquitos and other Diptera, a flea (*Ctenocephalides felis felis* (Bch.) on *Cuniculus* and man) and ticks of the genus *Amblyomma*.

HEISCH (R. B.), NELSON (G. S.) & FURLONG (M.). **Studies in filariasis in East Africa. 1. Filariasis on the Island of Pate, Kenya.**—*Trans. R. Soc. trop. Med. Hyg.* **53** no. 1 pp. 41–53, 2 figs., 36 refs. London, 1959.

An account is given of a study made from July 1956 to September 1957 of filariasis caused by *Wuchereria bancrofti* in the village of Faza on Patta (Pate) Island off the Kenya coast [*cf. R.A.E.*, B **46** 128]. *W. bancrofti* was found in 32 per cent. of samples of night blood and 4 per cent. of day blood, and the average numbers of microfilariae per 20 cu. mm. were 9·4 and 0·16, respectively. The highest parasite rates and densities were found in people 16–20 years old, and rates were higher in males than in females, though women would seem to be more exposed to infection than men. Seven species of filariae were found in animals.

The commonest mosquitos in houses were *Aëdes pembaensis* (Theo.)

[*cf.* **46** 129], *Culex pipiens fatigans* Wied. and *A. aegypti* var. *queenslandensis* (Theo.) [*cf.* **47** 22, etc.]. *A. pembaensis* was also abundant in the bush. It was mainly nocturnal, with biting peaks in the morning and evening [**47** 80], and was most plentiful in the dry months, numbers falling off markedly during the rains [*cf.* **47** 79]. The females bit man avidly but also fed readily on cats, monkeys and donkeys, and precipitin tests, particularly those on specimens from crab holes, indicated that it also feeds on dogs, cattle and goats. *C. p. fatigans* and *A. aegypti*, though predominantly anthropophilic, also fed on animals, and a number of females of the former contained avian blood. This species bred in cement tanks and pit latrines in houses and in soakage pits outside mosques, and showed marked seasonal incidence, almost disappearing during the dry months and increasing suddenly during the rains. *A. aegypti* showed a marked increase with the heavy rains in April and May. The only adults of Anophelines taken were three examples of *Anopheles gambiae* Giles.

The percentage rates of infection with filarial larvae and (in brackets) infective filarial larvae in over 15,000 mosquitos dissected were 3–4 (2–3) for *Aëdes pembaensis*, about 2 (less than 1) for *A. aegypti*, and about 25 (7) for *C. p. fatigans* before a campaign of mass treatment of the people with diethylcarbamazine and about 6 (1) after it. The rates in the first two species were unaffected by the campaign. In feeding experiments, only *W. bancrofti*, *Dirofilaria immitis* and a species of *Setaria* from donkeys developed well in *C. p. fatigans*, but *A. pembaensis* proved a good experimental host of five species from animals. It was found possible to distinguish most of the infective larvae in the host mosquitos, and they were studied in 187 females found infected in nature. *C. p. fatigans* contained only *W. bancrofti*, and *A. pembaensis* and *A. aegypti* only animal filariae. It is concluded that *C. p. fatigans* is the only vector of *W. bancrofti* at Faza.

RAMAKRISHNA (V.) & ELLIOTT (R.). **Insecticide resistance in** *Anopheles gambiae* **in Sokoto Province.**—*Trans. R. Soc. trop. Med. Hyg.* **53** no. 1 pp. 102–109, 3 figs., 8 refs. London, 1959.

Data have been given in earlier papers [*R.A.E.*, B **48** 233, etc.] on resistance to dieldrin in *Anopheles gambiae* Giles in localities inside and outside the area of the pilot scheme for the eradication of this mosquito in western Sokoto (Northern Nigeria). The further investigations on the distribution of resistance to insecticides that are the subject of the present paper were made by exposure of fourth-instar larvae from eight towns in or near the area to aqueous dilutions of γ BHC and DDT, with a short exposure period of one hour [**49** 16]. The towns had different histories as regards spraying of insecticides.

The following is based mainly on the authors' summary of the results. The degree to which the normal population has been replaced by one bearing the gene conferring resistance to dieldrin and BHC varied according to the different insecticidal regimens that had been applied. At Jega, where BHC only had been applied for 2½ years, the population appeared to be homozygous for this gene, and also to possess an additional minor resistance factor specific for BHC, which produced effects comparable in scale to those produced by 'vigour tolerance.' At Kalgo, Gwandu, Ambursa and Birnin Kebbi, where dieldrin only had been used, or dieldrin followed by BHC for a short period, a mixed population was found, consisting of homozygous- and heterozygous-resistant material, with little indication of the presence of homozygous-susceptible individuals. At Argungu and

Diggi, where BHC had been used once or twice only, the process of replacement had not advanced so far, and pure susceptible material was still present. The resistance factor was seen to have spread to places where no insecticides had yet been used and 6 per cent. homozygous-resistant material and only 42 per cent. homozygous-susceptible was found at Sokoto [*cf.* **48** 233] at least 14 miles from the nearest sprayed area. No sign of cross resistance to DDT could be detected.

JORDAN (P.). **A note on the effect of a blood meal on infective larvae of** *Wuchereria bancrofti* **in** *Culex fatigans.—Trans. R. Soc. trop. Med. Hyg.* **53** no. 2 pp. 148–150, 4 refs. London, 1959.

The incidence and distribution of infective larvae of *Wuchereria bancrofti* in laboratory-bred and infected females of *Culex pipiens fatigans* Wied. was determined immediately after a second blood-meal and compared with that in similar females that had taken their initial meal at the same time and been kept under identical conditions but not fed a second time. The number of infective larvae from all parts of the mosquitos that had had a second meal was found to be much reduced. It is unlikely that these larvae are passed in the dejecta and more probable that they migrate to the proboscis under the influence of the second meal and escape in that way. In view of this, it is suggested that when the incidence of infective mosquitos is being determined, it should be based on the number of mosquitos with infective larvae anywhere in the body and not only those with larvae in the proboscis. It is also suggested that if infected mosquitos had blood-meals at regular intervals, as they would in nature, there would be no large accumulation of the filaria larvae to produce lethal effects in them [*cf. R.A.E.*, B **42** 202; **47** 20; **49** 41].

MANSON-BAHR (Sir P.). **The story of** *Filaria bancrofti.* **A critical review.**—*J. trop. Med. Hyg.* **62** no. 3 pp. 53–61; no. 4 pp. 85–94; no. 5 pp. 106–117; no. 6 pp. 138–145; no 7 pp. 160–173, 20 figs., refs. London, 1959.

The fourth part of this critical review of the history of research on *Wuchereria* (*Filaria*) *bancrofti* and its transmission includes a list of the mosquitos in which it completes its development, a geographically arranged list of the vectors of the type with nocturnal periodicity (with the authority in most cases) and a list (showing the distribution of each) of the members of the subgroup of *Aëdes scutellaris* (Wlk.) [*R.A.E.*, B **43** 173], which are the main vectors of the non-periodic form. There is also a map showing the main vectors of both types in Pacific territories.

ŘEHÁČEK (J.). **Přežívání virusu severoamerické encefalomyelitidy koní východního typu (EEE) v klíšťatech** *Ixodes ricinus* **L. a** *Dermacentor marginatus* **Sulz.** [Survival of the virus of North American equine encephalitis of the eastern type (EEE) in the ticks, *I. ricinus* and *D. marginatus.*]—*Biológia* **14** pt. 9 pp. 688–693, 8 graphs, 13 refs. Bratislava, 1959. (With summaries in Russian & German.)

During studies in connection with an outbreak of tick-borne encephalitis in horses in Czechoslovakia, the virus of eastern equine encephalitis was isolated from *Clethrionomys glareolus* and *Sorex araneus* and from nymphs of *Ixodes ricinus* (L.). The fate of the virus in ticks (*I. ricinus* and

Dermacentor marginatus (Sulz.)) when ingested by them with the blood of infected animals was investigated, and it was found that the virus was localised in the digestive tract of the female ticks and persisted, without increasing, for not more than a week at 35°C. [95°F.], for up to 23 days at 25°C. [77°F.] and for more than a month at 4°C. [39·2°F.], inactivation occurring gradually.

D'yakonov (L. P.). **The rôle of** *Rhipicephalus turanicus* **Pom. in the epizootiology of haemosporidioses of sheep.** [*In Russian.*]—*Veterinariya* **36** no. 3 pp. 30–32. Moscow, 1959. (With a summary in English.)

Adults of *Rhipicephalus turanicus* Pom. taken in the spring of 1958 from sheep infected with *Anaplasma ovis* and *Theileria ovis* (*recondita*) in the Stavropol region transmitted both parasites to a ram to which they were transferred. This tick is widely distributed in the North Caucasus, Transcaucasia and Soviet Central Asia, infests sheep in great numbers (100–500 per animal), and is the commonest one on them in spring and summer.

Burgdorfer (W.) & Eklund (C. M.). **Studies on the ecology of Colorado tick fever virus in western Montana.**—*Amer. J. Hyg.* **69** no. 2 pp. 127–137, 1 map, 5 refs. Baltimore, Md., 1959.

The following is based on the authors' summary. During a study of the ecology of the virus of Colorado tick fever [*cf. R.A.E.*, B **44** 106] in a small region of western Montana in 1958, various stages of *Dermacentor andersoni* Stiles and their commonest host animals were investigated to ascertain their importance in maintaining and distributing the virus. The golden-mantled ground squirrel (*Citellus lateralis tescorum*) was found to be a preferred host for the larvae and nymphs and the main carrier of the virus, which was isolated from 28 of 61 individuals caught in June–September. Up to 16 per cent. of the adult ticks collected from vegetation in areas populated by this ground squirrel contained the virus. From 209 Columbian ground squirrels (*C. columbianus columbianus*) tested individually, 27 virus isolations were made, the earliest on 13th May and the latest on 21st August. Most of the infected individuals were found in an area inhabited also by *C. l. tescorum*. In adjacent areas where the latter was not present, lower infection rates were found in *D. andersoni* as well as in *C. columbianus*. The virus was not isolated from adult ticks or rodents in an area populated only by a large colony of *C. columbianus*. Among other animals, it was isolated from 5 out of 26 chipmunks (*Eutamias amoenus*), 1 out of 4 pine squirrels (*Tamiasciurus hudsonicus richardsoni*) and 1 out of 6 deer mice (*Peromyscus maniculatus*), but not from two porcupines (*Erethizon dorsatum*) or four snowshoe rabbits (*Lepus americanus*). It is concluded that Colorado tick fever appears to be characterised by sharply localised areas of infection correlated in this instance with the presence of *C. l. tescorum*.

Rozeboom (L. E.) & Burgdorfer (W.). **Development of Colorado tick fever virus in the Rocky Mountain wood tick,** *Dermacentor andersoni.*—*Amer. J. Hyg.* **69** no. 2 pp. 138–145, 1 graph, 6 refs. Baltimore, Md., 1959.

The following is based on the authors' summary. Nymphs of *Dermacentor andersoni* Stiles that ingested the virus of Colorado tick fever in doses ranging from $10^{1 \cdot 5}$ to more than $10^{4 \cdot 5}$ times the LD50 for suckling mice, by feeding on infected hamsters, maintained the virus during transformation to the adult stage. Generally, virus concentrations ingested remained constant through quiescence of nymphs but increased from $10^{0 \cdot 2}$ to $10^{3 \cdot 7}$ mouse LD50's during metamorphosis to the adult stage, or shortly thereafter. In some series, a drop in virus concentration was noted during the quiescent period, but increases in virus from $10^{1 \cdot 5}$ to $10^{3 \cdot 7}$ mouse LD50's had occurred by the time the ticks had become adult. Freshly moulted nymphs that as larvae had ingested up to $10^{2 \cdot 5}$ LD50's also showed significant increases in virus concentration. When large amounts of virus were ingested by larvae, no increases in concentration were noted in freshly moulted nymphs. No difference in amounts of virus was found in males and females of *D. andersoni*, and no significant loss of virus occurred in ticks that were retained for ten months or longer.

Stampa (S.), Fiedler (O. G. H.) & Du Toit (R.). **The protection of sheep against blowfly strike. V. The duration of protection of certain insecticides under field conditions.**—*Onderstepoort J. vet. Res.* **27** no. 4 pp. 549–581, 7 figs., 8 refs. Pretoria, 1958.

The following is based largely on the authors' summary of this fifth part of a series [*cf. R.A.E.*, B **46** 143, etc.]. An account is given of large numbers of field trials carried out under close supervision in South Africa in parts of the Karoo, in which sheep are subject to infestation by blowflies [*cf.* **41** 68], to investigate certain biological aspects of strike and the protection afforded to sheep by diazinon, dieldrin, aldrin and BHC under natural conditions. The biological factors rendering sheep susceptible to blowfly strike are reviewed, and the development of strikes in treated sheep is compared with that in untreated ones. The larvicidal effectiveness of the compounds tested is discussed, as well as the factors influencing the duration of protection afforded by them [*cf.* **44** 89; **46** 143].

Dusts and wettable powders gave longer protection from crutch strike than emulsions when the crutch was clean and dry, whereas emulsions and wettable powders, particularly the former, gave better results than dusts on soiled sheep. The protecting agent must be evenly distributed throughout the vulnerable areas of the fleece right down to skin level to ensure the maximum degree of protection. No significant difference in duration or degree of protection was observed with quantities of toxicant varying from 0·425 to 2·84 g. per sheep applied to the crutch region. This is probably because the amount of protecting agent is not so important as other factors, and it therefore seemed advisable to apply the optimum dose as judged by standards of economy. This was between 0·8 and 1·1 g. per crutch for diazinon, dieldrin or aldrin, which are regarded as the insecticides of choice. Insecticides gave better protection when applied to long wool than to short wool. The clipping of the crutches of dirty sheep before treatment is therefore inadvisable, even though the uniformity of application and consequently the duration and degree of protection are reduced when the crutches are soiled at the time of treatment.

All the insecticides protected young lambs for a considerably shorter time than adult sheep with wool of the same length or even shorter. The reason for this has not been fully investigated but appears to lie in differences in the structure and density of the fleece. The incidence of blowflies exercised a more significant influence than any other factor on the duration of protection afforded by any of the insecticides. The relationship between fly incidence and duration of protection follows the equation of a hyperbola.

The duration of protection afforded by diazinon, dieldrin and aldrin showed no significant differences under equal conditions; BHC, however, was markedly inferior, and it is concluded that it is not stable enough to afford adequate protection with the fly incidence normally met with in typical infested areas. Mules' operation [**32** 142] was shown to afford adequate protection from crutch strike as long as the incidence of flies was low and the wool fairly short, but with higher fly activity, the protection afforded decreased rapidly.

PAPERS NOTICED BY TITLE ONLY.

PAGE (W. A.) & MCDONALD (W. A.). **An assessment of the degree of man-fly contact exhibited by** *Glossina palpalis* **at water-holes in Northern and Southern Nigeria.**—*Ann. trop. Med. Parasit.* **53** no. 2 pp. 162–165, 5 refs. Liverpool, 1959. [*Cf. R.A.E.*, B **48** 151.]

COLLESS (D. H.). **Notes on the Culicine mosquitoes of Singapore. V. The** *Aëdes niveus* **subgroup (Diptera, Culicidae):** [redescriptions of] **previously described species and keys to adults and larvae** [of species occurring in the Singapore–Malaya area].—*Ann. trop. Med. Parasit.* **53** no. 2 pp. 166–179, 10 refs. Liverpool, 1959. [*Cf. R.A.E.*, B **48** 237, etc.].

BÜTTIKER (W.) & BEALES (P.). *Anopheles pampanae*, **a new species of mosquito from Cambodia.**—*Acta trop.* **16** no. 1 pp. 63–69, 2 figs., 2 refs. Basle, 1959.

TARSHIS (I. B.). **Feeding** *Culex tarsalis* **on outdated whole human blood through animal-derived membranes (Diptera: Culicidae).**—*Ann. ent. Soc. Amer.* **52** no. 6 pp. 681–687, 5 figs., 27 refs. Washington, D.C., 1959.

BROWN (A. W. A.). **The insecticide-resistance problem. A review of developments in 1956 and 1957.**—*Bull. World Hlth Org.* **18** no. 3 pp. 309–321, 77 refs. Geneva, 1958. (With a summary in French.)

BRADBURY (F. R.) & STANDEN (H.). **Mechanisms of insect resistance to the chlorohydrocarbon insecticides** [review of resistance to DDT and BHC, chiefly in *Musca domestica* L.].—*J. Sci. Fd Agric.* **11** no. 2 pp. 92–100, 4 figs., 38 refs. London, 1960.

Theiler (G.) & Salisbury (L. E.). **Zoological survey of the Union of South Africa. Tick survey. Part X. Distribution of** *Margaropus winthemi*, **the winter horse tick.**—*Onderstepoort J. vet. Res.* **27** no. 4 pp. 599–604, 1 col. fldg. map. Pretoria, 1958. **Part XI. The distribution of** *Otobius megnini*, **the spinose ear tick.**—*T. c.* pp. 605–610, 1 col. fldg. map.

In the first of these parts of a series [*cf. R.A.E.*, B **46** 188, etc.], the distribution of *Margaropus winthemi* Karsch in the Union of South Africa, where it is seen on horses and cattle mainly in the winter months (May–August), is shown on a map, discussed in relation to vegetation, humidity, temperature and altitude and set out in detail in relation to veterinary control areas.

In the second part, similar information is given for *Otobius megnini* (Dugès), which was introduced into South Africa from America and has become established in farms in many parts of the country. It has also been recorded from the Belgian Congo and Nyasaland. The factor limiting its distribution appears to be high rainfall, since it has not been recorded from areas receiving more than 40 in. rain annually. It has probably not been introduced into all areas of the Transvaal. No seasonal periodicity has been observed.

Harrison (I. R.). **The effect of Dow ET-57 on warble fly larvae and lice infestations in cattle.**—*Vet. Rec.* **70** no. 42 pp. 849–852, 3 figs., 5 refs. London, 1958.

Fenchlorphos (Dow ET-57) administered in bolus form for the control of larvae of *Hypoderma* in cattle was evaluated in two tests in England in 1957–58. Cattle were treated at least one month before the arrival of larvae in the backs, at rates of 100–130 mg. per kg. body weight. In 19 treated and 19 untreated animals, two and 109 larvae, respectively, reached the back, and all were of *H. bovis* (Deg.). Fewer larvae were found in the backs of older animals than in those of younger ones. Infestations of sucking lice, *Haematopinus eurysternus* (Nitzsch) and *Solenopotes capillatus* End. were reduced, but there was no effect on the few biting lice, *Damalinia bovis* (L.), present. Moderate transient toxic symptoms occurred in five of the treated animals. Blood taken $\frac{3}{4}$–19 (but not 24) hours after treatment was toxic to adults of *Stomoxys calcitrans* (L.) and larvae of *Lucilia sericata* (Mg.).

Sicart (M.), Ruffié (J.) & Meira (M.). **L'évolution larvaire de** *Oestrus ovis* (**Linné, 1761**).—*Ann. Parasit. hum. comp.* **33** no. 3 pp. 295–302, 2 figs., 5 refs. Paris, 1958.

Details are given of morphological studies on the larvae of *Oestrus ovis* L., which showed that there are four clearly differentiated instars, and not three, as had formerly been supposed.

Bruyning (C. F. A.). **Een bijzonder geval van myiasis veroorzaakt door** *Dermatobia hominis* (**Linnaeus junior**) **in Suriname.** [An unusual case of myiasis caused by *D. hominis* in Dutch Guiana.]—*Ent. Ber.* **19** no. 1 pp. 7–13, 11 refs. Amsterdam, 1959. (With a summary in English.)

The following is virtually the author's summary. A case of cutaneous myiasis caused by *Dermatobia hominis* (L. jr.) in Dutch Guiana is described.

The unfavourable localisation between the skull and the skin caused the larva to make long "galleries" and delayed its development considerably; after a period of at least five weeks, the larva was still small. In an advanced stage, the larva caused bone conduction to the auditory centre by scratching against the skull. A description is given of the method by which the Oajanay Indians remove the larvae by using a spine of a palm tree and condensed smoke.

Koone (H. D.) & Banegas (A. D.). **Biology and control of** *Dermatobia hominis* **(L. jr.) in Honduras (Diptera: Cuterebridae).**—*J. Kans. ent. Soc.* **32** no. 3 pp. 100–108, 11 refs. Manhattan, Kans., 1959.

The following is based on the authors' summary. *Dermatobia hominis* (L. jr.) is a major pest of cattle in half the area of Honduras. The female does not lay its eggs on the cattle, but deposits them on the underside of the abdomen of other Diptera. Of six species of Diptera found carrying eggs in Honduras, *Musca pruna* (Shann. & Del Ponte) (*Sarcopromusca arcuata* (Tns.)) was the most important. These egg-carriers are attracted to and apparently feed on the pus exuded from abscesses caused by *D. hominis*, which accounts for the continual infestation of animals on which such abscesses are present. *D. hominis* thrives in areas where rainfall is moderate to heavy and the dry season not extreme; dry soil does not favour the survival of the pupae. It tends to prefer damp, brushy pastures [*cf. R.A.E.*, B **48** 13], and the heaviest infestations occur towards the end of the rainy season. The complete life-cycle requires 90–110 days, and the larval stage lasts about 40 days [*cf.* **41** 35]. In 1955–56, larval populations were reduced to a very low level by spraying cattle with 0·5 per cent. toxaphene [**42** 5, etc.] or a mixture of 0·5 per cent. DDT and 0·05 per cent. BHC at intervals of 15–20 days. Three or four successive treatments were required before populations were greatly reduced. In 1958, Narlene [O-methyl O-(4-tert.-butyl-2-chlorophenyl) methylphosphoramidothioate] given orally as a drench at 20 mg. per kg. body weight or applied as a 0·75 per cent. spray caused almost complete mortality of larvae encysted in cattle [*cf.* **48** 26]. Re-infestation was noticed 30 days after treatment, but was limited mainly to animals with large sores or abscesses that had not completely healed.

Herms (W. B.). **Medical entomology.** Revised by M. T. James.—5th edn., $9\frac{1}{2} \times 6\frac{1}{4}$ in., xi+[1+] 616 pp., 185 figs., many refs. New York, N.Y., Macmillan Co., 1961. Price £4 7*s*. 6*d*.

This is a revision of the fourth edition of a well-known text-book [*cf. R.A.E.*, B **39** 98, etc.] on arthropods that transmit disease. The arrangement of the earlier editions is closely followed, but some parts of the text, notably those dealing with insects that attack domestic animals, have been reduced or omitted to allow of the inclusion, without increasing the total size, of new material more strictly concerned with medical entomology. Information on control has been brought up to date, and a number of new keys and some anatomical material have been added.

Steinhaus (E. A.) & Smith (R. F.). Ed. **Annual review of entomology. Volume 6.**—9 × 6 in., viii+470 pp., illus., many refs. Palo Alto, Cal., Annual Reviews, Inc., 1961.

The reviews in this sixth volume of a series [*cf. R.A.E.*, B **45** 27; **48** 68, etc.], all of which are noticed elsewhere [A **49** 157], include: **Biology of**

chiggers, by M. Sasa (pp. 221–244, 114 refs.), which is a review of knowledge on the distribution, bionomics, laboratory rearing, host relations and importance as disease vectors of Trombiculids; **Mechanism of transmission of viruses by mosquitoes,** by R. W. Chamberlain & W. D. Sudia (pp. 371–390, 86 refs.); **Arthropod vectors as reservoirs of microbial disease agents,** by C. B. Philip & W. Burgdorfer (pp. 391–412, 215 refs.), in which the agents considered are viruses, rickettsiae, bacteria and Protozoa that cause disease in man or domestic animals and are transmitted by insects, mites or ticks; and **Transmission of filarioid nematodes,** by F. Hawking & M. Worms (pp. 413–432, 148 refs.), which includes a list of the filarial worms that attack man or animals and are known to develop in arthropods, showing their animal and arthropod hosts and the site of development in the arthropod.

In addition to the index to the authors whose work is reviewed and one to the subjects discussed, cumulative indexes to the reviews, classified under broad headings, and to the contributing authors in volumes 2–6 of the series are appended.

Zanina (Z. L.). **Biological characteristics of the forest malaria mosquito, *Anopheles bifurcatus* L. (Diptera, Culicidae), in the Rushan district of the western Pamirs.** [*In Russian.*]—*Rev. Ent. URSS* **37** pt. 4 pp. 856–868, 6 figs., 19 refs. Moscow, 1958. (With a summary in English.)

The following is largely the author's summary. Investigations in the Rushan district of eastern Tadzhikistan in 1954–55 showed that *Anopheles claviger* (Mg.) (*bifurcatus*, auct.) develops in well-shaded water near human settlements. Its daytime resting places were in vegetation and crevices and in animal quarters near water. Of the engorged females examined, 57 per cent. contained human blood. There were three generations a year, but considerable mortality occurred as a result of overpopulation in the breeding places and the general sparseness of vegetation. There were many more females than males, and the females, which were autogenous [*cf. R.A.E.*, B **31** 155, etc.], in some cases lived until the fifth gonotrophic cycle. *A. claviger* is assumed to be an important vector of malaria in the district.

Kalmus (H.) & Hocking (B.). **Behaviour of *Aedes* mosquitos in relation to blood-feeding and repellents.**—*Ent. exp. appl.* **3** no. 1 pp. 1–26, 1 pl., 4 figs., 47 refs. Amsterdam, 1960. (With a summary in German.)

The following is virtually the authors' summary of this account of observations carried out in Alberta. About 4,000 females of *Aëdes aegypti* (L.) and 2,000 of several Canadian species of *Aëdes* were studied in the laboratory and the latter also in the field. Their behaviour in relation to a host and to repellent chemicals was divided into eight phases, and the conditions influencing them as well as the stimuli responsible for the initiation, inhibition and termination of these phases were investigated; orientation was also considered. The factors studied included surface temperature, convective and radiant heat, light and colour, moisture, wind, odour, taste, gravitation, sound and movement. The relevance of the results for the development of improved mosquito-repellent chemicals is discussed.

DONNELLY (J.). **The effect of gamma radiation on the viability and fertility of *Lucilia sericata* Mg. (Dipt.) irradiated as pupae.**—*Ent. exp. appl.* **3** no. 1 pp. 48–58, 8 refs. Amsterdam, 1960. (With a summary in French.)

The following is substantially the author's summary. The biological effects of γ-radiation on *Lucilia sericata* (Mg.) were studied by subjecting the pupae to a range of doses from radioactive cobalt (^{60}Co). Observations were made on the percentage giving rise to adults after each treatment and the length of life of the adults. Fertility was measured by caging each sex with untreated flies of the opposite sex, the numbers of hatching egg clusters obtained providing an index of fertility of the treated component.

Percentage emergence, in pupae more than three days old at irradiation, was normal up to 12,000 rep, and reduced by about 24 per cent. after 24,000 rep. Adult life was progressively reduced by doses from 1,000 rep upwards, and was about 50 per cent. of the control value after 9,000 rep. The percentage viability of eggs from treated females decreased as the dosage rose to 2,000 rep without any decrease in total eggs produced, but after 3,000 rep and above females failed to lay any eggs. Male fertility was about 3 per cent. after 3,000 rep; above 3,000 rep males were completely sterile. Morphologically normal sperm was produced by males at all doses up to 24,000 rep, and motility was demonstrated up to 6,000 rep at least.

Pupae irradiated before completion of a third of the total duration of the pupal stage failed to give rise to adults after 3,000 rep; those irradiated after that stage did so normally after 12,000 rep. There was evidence that the transition from susceptibility to resistance was abrupt and that the physiological age of the pupae corresponding to this resistance threshold was independent of the velocity of pupal development.

BARRASS (R.). **The settling of tsetse flies *Glossina morsitans* Westwood (Diptera, Muscidae) on cloth screens.**—*Ent. exp. appl.* **3** no. 1 pp. 59–67, 3 graphs, 29 refs. Amsterdam, 1960. (With a summary in German.)

The following is virtually the author's summary of this account of experiments in Southern Rhodesia. It was found that tsetse flies (nearly all *Glossina morsitans* Westw.) prefer to settle on the darker of two screens, but contrary to expectation, on the sunny side of the screen rather than on the shaded side. The attractiveness of a black and white striped screen diminished progressively as the width of the white stripes was increased, but even narrow white stripes made a screen less attractive than an all-black control. This breaking up of the black screen was important, since white adjacent to a black screen did not reduce its attractiveness.

VAN ASPEREN (K.) & OPPENOORTH (F. J.). **The interaction between organophosphorus insecticides and esterases in homogenates of organophosphate susceptible and resistant houseflies.**—*Ent. exp. appl.* **3** no. 1 pp. 68–83, 3 graphs, 8 refs. Amsterdam, 1960. (With a summary in German.)

The following is virtually the authors' summary. Homogenates of houseflies (*Musca domestica* L.) contain different esterases, which compete for added organophosphates. Among these, cholinesterase and an aliesterase rank first. If small amounts of organophosphates are added, the final result of the competition depends on the amounts of the esterases present and their reaction rates. The bimolecular rate constants show that the aliesterase is a powerful competitor of the cholinesterase for dichlorvos (DDVP), paraoxon and diazoxon (diethyl 2-isopropyl-4-methyl-6-pyrimidinyl phosphate). Accordingly, it was found that removal of the aliesterase by denaturation (AD-treatment) strongly enhances the inhibition of cholinesterase by these three compounds, but not by amiton oxalate (Tetram) or QAT (O-ethyl S-2-triethylammoniumethyl ethylphosphonothioate).

In homogenates of organophosphate-resistant flies, which as previously shown contain much less aliesterase [*R.A.E.*, B **48** 161], cholinesterase inhibition was generally much stronger than in 'susceptible homogenates'. It seemed difficult to reconcile these findings with previous observations showing that low aliesterase activity and resistance are closely connected. Further studies, however, showed that resistant flies contain a modified aliesterase that has the capacity of degrading the organophosphates (P=O compounds) to which resistance has developed. The change of the aliesterase (in susceptible flies) into a 'phosphatase' (the modified enzyme in resistant flies) is due to a single gene mutation, which in the two resistant strains investigated is also responsible for the resistance. In each of these two strains, the phosphatase shows a very high affinity for its substrates, paraoxon and diazoxon.

IKEDA (Y.). **Insect repellents and attractants. Part II. On the estimation of efficiencies of pyrethrins and allethrin as fly repellent.**—*Botyu-Kagaku* **23** pt. 1 pp. 33–36, 1 fig., 9 refs. Kyoto, 1958. (With a summary in Japanese.)

In the experiments described, filter papers were impregnated with benzene solutions of the test compounds and kept for various periods at 26–32°C. [78·8–89·6°F.], after which a lactose pellet was placed in the centre of each and adults of *Musca domestica vicina* Macq. exposed to the papers in a glass cylinder. The amount of feeding on the pellets was used to measure the repellency of the test compounds. In the first test, various chlorinated terphenyls did not prolong the repellency of Tabutrex (di-n-butyl succinate), and some of them reduced it. In the second, allethrin and pyrethrins at 0·2 mg. were about as effective as Tabutrex at 10 mg. per 20 sq. cm., and their addition to Tabutrex increased its effectiveness for a few days but failed to prolong it.

IKEDA (Y.). **Insect repellents and attractants. Part III. The olfactory repellencies of some esters of camphoric acid to Culicine mosquitoes.**—*Botyu-Kagaku* **23** pt. 2 pp. 63–65, 4 refs. Kyoto, 1958. (With a summary in Japanese.)

In tests of repellents against *Culex tritaeniorhynchus* Giles and *C. pipiens pallens* Coq. in Japan, the dimethyl ester of camphoric acid proved superior to other esters and to dimethyl phthalate, but both were inferior to camphor oil, though longer-lasting.

KITAOKA (S.) & YAJIMA (A.). **Field experiments on the control of chicken mites with pesticides.** [*In Japanese.*]—*Botyu-Kagaku* **23** pt. 2 pp. 55–60, 1 fig., 20 refs. Kyoto, 1958. (With a summary in English.)

After preliminary laboratory tests, fowl houses and batteries in Tokyo were sprayed with acaricides for the control of *Dermanyssus gallinae* (Deg.).

The mites were almost eradicated by 0·025 per cent. malathion, 0·05 per cent. trichlorphon (Neguvon), 0·017 per cent. allethrin or 0·13 per cent. Kelthane and remained very scarce for at least 20 days after treatment. Higher concentrations gave no additional control, but a second application was beneficial. Other materials were less effective. Laying hens were not adversely affected by the toxicants.

Shôgaki (Y.) & Yoshida (Y.). **Studies on the black flies of Yase District in Kyoto-city and their control. II. On the control of black fly larvae by lindane emulsions in the natural streams.** [*In Japanese.*]—*Jap. J. appl. Ent. Zool.* **2** no. 3 pp. 157–170, 4 figs., 28 refs. Tokyo, 1958. (With a summary in English.)

Several species of *Simulium* breed in streams near Kyoto, but almost all the bites on man and domestic animals are due to *S. nacojapi* Smart. Treatment of the streams with γ BHC used as lindane at 1 part per million in an emulsion for 15 minutes once a month from February 1956 to November 1957 resulted in good control of the larvae and reduced the biting rate on man by 36·2 per cent. Other arthropods were also destroyed, which may have depleted the supply of food for fish, but there were no harmful effects on one species of fish that is of importance in the district.

Smith (H. J.). **Detection and estimation of the biologically active constituents of pyrethrum.**—*J. Sci. Fd Agric.* **11** no. 3 pp. 172–176, 2 graphs, 9 refs. London, 1960.

The following is the author's summary. A method is described for the determination of cinerin I, pyrethrin I, cinerin II and pyrethrin II in pyrethrum preparations based upon quantitative preparation and chromatographic separation of their 2,4-dinitrophenylhydrazones. The method is rapid and is suitable for routine analysis.

Donaldson (J. M.) & Stevenson (J. H.). **The stabilising effect of piperonyl butoxide on pyrethrins exposed to ultra-violet light.**—*J. Sci. Fd Agric.* **11** no. 7 pp. 370–373, 8 refs. London, 1960.

Since piperonyl butoxide has a negligible effect on the toxicity of pyrethrins to adults of *Cadra* (*Ephestia*) *cautella* (Wlk.) [*cf. R.A.E.*, A **48** 241], this moth was selected for tests, which are described, of a possible stabilising effect of the synergist on pyrethrins during irradiation with ultraviolet light [*cf.* B **47** 69]. No such stabilisation was demonstrated.

Knapp (F. W.) & Krause (G. F.). **Control of the northern fowl mite, *Ornithonyssus sylviarum* (C. & F.), with ronnel, Bayer L13/59 and Bayer 21/199.**—*J. econ. Ent.* **53** no. 1 pp. 4–5, 6 refs. Menasha, Wis., 1960.

As dusts of trichlorphon (Bayer L 13/59) and coumaphos (Bayer 21/199) gave good control of *Ornithonyssus sylviarum* (C. & F.) on fowls [*R.A.E.*, B **45** 114], these two compounds and fenchlorphos (ronnel) were tested for the control of this mite on 594 hens and 100 roosters in Kansas in 1959; the following is substantially the authors' abstract of the results. Coumaphos as 0·5 and 0·25 per cent. dusts, and trichlorphon and fenchlorphos as 1 per cent. dusts were applied to individual birds on four areas of the body at the rate of 3–4 g. per bird. Each gave satisfactory control up to 28 days after treatment and apparently any of the compounds would virtually eradicate the mites if no birds were left untreated. No detectable residue could be found in the eggs of hens treated with coumaphos or fenchlorphos; no eggs from hens treated with trichlorphon were tested. There was no difference in the flavour of the treated and untreated eggs.

Brady jr. (U. E.), Dorough (H. W.) & Arthur (B. W.). **Selective toxicity and animal systemic effectiveness of several organophosphates.**—*J. econ. Ent.* **53** no. 1 pp. 6–8, 1 fig., 11 refs. Menasha, Wis., 1960.

The following is based mainly on the authors' abstract. In laboratory tests, the toxicity of 17 organophosphates to rats varied with the substituents surrounding the phosphorus atom and the route of administration. The eight compounds that were more toxic to rats when given orally than when injected subcutaneously were all phosphorothioates or phosphorodithioates, and five of them contained thioether or thiophenyl groups in the acid residue portion of the molecule. The six compounds that were more toxic to rats when administered subcutaneously than when given orally contained dimethyl groups; three were phosphates, two phosphorothiolates and one a phosphorodithioate. The compounds with the lowest toxicity to rats when applied orally and the highest to females of *Musca domestica* L. when applied topically, were dimethoate, Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate), and Bayer 29493 (O,O-dimethyl O-3-methyl-4-methylthiophenyl phosphorothioate). Dimethoate, Bayer 29493, Bayer 23453 (O,O-dimethyl S-2-(ethylsulphinyl)ethyl phosphorodithioate), Bayer 24498 (O,O-dimethyl S-2-(methylsulphinyl)ethyl phosphorothioate), Bayer 25198 (O,O-dimethyl O-p-methylsulphinylphenyl phosphorothioate) and Shell SD3562 (3-(dimethoxyphosphinyloxy)-N,N-dimethylcrotonamide) administered orally to rabbits were effective against *Cimex lectularius* L. and *Amblyomma maculatum* Koch. When fifth-instar nymphs of *C. lectularius* were fed on rabbits at various intervals after treatment, dimethoate and Shell SD3562 gave 100 per cent. mortality for two hours, Bayer 24498 for four hours, Bayer 25198 for six hours and Bayer 23453 and 29493 for 14 hours.

Bigley (W. S.), Roth (A. R.) & Eddy (G. W.). **Laboratory and field tests against mites and lice attacking poultry.**—*J. econ. Ent.* **53** no. 1 pp. 12–14, 3 figs., 2 refs. Menasha, Wis., 1960.

The following is based mainly on the authors' abstract. In laboratory tests, deposits of fenchlorphos (ronnel) on cloth were more toxic to *Ornithonyssus sylviarum* (C. & F.) than deposits of malathion or barthrin [6-chloropiperonyl chrysanthemate], and *Dermanyssus gallinae* (Deg.) was less susceptible to the first two than was *O. sylviarum*. In sprays, dicapthon and fenchlorphos were more effective than malathion, barthrin or N,N-diethyl-m-toluamide on fowls infested with the latter, and malathion and fenchlorphos were effective against *Menacanthus stramineus* (Nitzsch). Excellent results were obtained with sprays of fenchlorphos and sprays or dusts of malathion in field tests on turkeys infested with *O. sylviarum* and with the first applied as a dust to the litter of hens infested with *M. stramineus*.

Ware (G. W.). **The penetration of piperonyl butoxide as a synergist and as an antagonist in *Musca domestica* L.**—*J. econ. Ent.* **53** no. 1 pp. 14–16, 2 figs., 8 refs. Menasha, Wis., 1960.

The following is based mainly on the author's abstract. Studies were made on the effect of Sevin and malathion on the rate of penetration of piperonyl butoxide acting as a synergist with the first and as an antagonist with the second [*cf. R.A.E.*, B **47** 13, etc.]. In each test, males of *Musca domestica* L. were treated topically with piperonyl butoxide in acetone alone or with the toxicant, and kept for 6, 12, 18 or 24 hours. The amounts of piperonyl butoxide received were determined colorimetrically from washings from the outsides of the survivors and from extracts of the washed insects after they had been ground up; 95 per cent. of the applied compound was recovered by these two processes. The results showed that piperonyl butoxide at first penetrated rather more slowly with than without the toxicants, but there was little difference in the proportions of the dose penetrating in 24 hours. Penetration was greater for the lower than for the higher of the two concentrations used. Less was recovered from the extracts when it was used alone than when it was accompanied by the toxicants, and it is assumed that the remainder was metabolised in the insects. The proportion concerned was greater for the lower than for the higher concentration of piperonyl butoxide. It is concluded that the penetration rate is not responsible for the synergistic or antagonistic action of piperonyl butoxide.

Krueger (H. R.), O'Brien (R. D.) & Dauterman (W. C.). **Relationship between metabolism and differential toxicity in insects and mice of diazinon, dimethoate, parathion, and acethion.**—*J. econ. Ent.* **53** no. 1 pp. 25–31, 4 figs., 11 refs. Menasha, Wis., 1960.

The following is based partly on the authors' abstract. The persistence and metabolism of diazinon, dimethoate and acethion (O,O-diethyl S-ethoxycarbonylmethyl phosphorodithioate), which are much more toxic to insects than to mammals, and of parathion, which is not, were studied in mice, *Periplaneta americana* (L.) and *Musca domestica* L. The results are considered to indicate that the selective toxicity of the first three is due to high levels of oxygen analogue in the susceptible species for diazinon and to the persistence of unaltered parent compound in them for dimethoate and acethion. The differences found in the absorption and metabolism of diazinon by normal house-flies and those resistant to it were small. Parathion treatment resulted in higher levels of paraoxon (the oxygen analogue) in the insects than in mice, without a corresponding difference in toxicity.

Lipke (H.) & Kearns (C. W.). **DDT-dehydrochlorinase III. Solubilization of insecticides by lipoprotein.**—*J. econ. Ent.* **53** no. 1 pp. 31–35, 2 figs., 23 refs. Menasha, Wis., 1960.

The use of DDT-dehydrochlorinase with lipoprotein-solubilised DDT is described as an example of solubilisation techniques in the metabolic study of insecticides *in vitro*.

Barker (R. J.). **Syntheses of the aliphatic deuterium analogs of DDT and TDE and their toxicity and degradation when applied to adult house flies.**—*J. econ. Ent.* **53** no. 1 pp. 35–41, 3 figs., 29 refs. Menasha, Wis., 1960.

The following is based on the author's abstract. The aliphatic deuterium analogue of DDT (1,1-di(p-chlorophenyl)-1-deuterium-2,2,2-trichloroethane) and that of DDD (TDE) (1,1-di(p-chlorophenyl)-1-deuterium-2,2-dichloroethane) were synthesised and used to measure the effect of the isotope on absorption spectra, toxicity to susceptible and resistant strains of *Musca domestica* L. and dehydrochlorination in alkaline solutions and DDT-resistant house-flies. As the analogues showed little change in toxicity or susceptibility to dehydrochlorination, these properties evidently involve the electronic structure of the molecule, and not mass effects.

Plapp jr. (F. W.), Bigley (W. S.) & Darrow (D. I.). **Studies on the metabolism and residues of P^{32}-labeled Delnav in a Hereford steer.**—*J. econ. Ent.* **53** no. 1 pp. 60–64, 13 refs. Menasha, Wis., 1960.

In the test described, Delnav (2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)) labelled with ^{32}P was applied as a spray to a steer and the residues and metabolic pathway were determined. Seven days after treatment, most of the insecticide was still on the hair, small amounts were found in the fatty tissues and in various organs and the bones, and only traces occurred in the muscles; residues of technical Delnav were not detectable in meat samples. The metabolic degradation of the insecticide occurred primarily by the cleavage of the P-S and S-C bonds, and this, coupled with oxidation of the P-S grouping to yield phosphoric acid, accounted for nearly all the *in vivo* hydrolysis products. Metabolic degradation in mice was the same, whether administration was oral, dermal or subcutaneous. The presence of phosphate or phosphorothioate compounds or both was demonstrated chromatographically in some of the minor fractions of technical Delnav [*cf. R.A.E.*, A **48** 215].

Bettini (S.), Boccacci (M.) & Natalizi (G.). **Cumulative effect of sublethal doses of myristyl chloroacetate on a highly DDT-resistant strain of** *Musca domestica* **L.**—*J. econ. Ent.* **53** no. 1 pp. 99–101, 2 figs., 12 refs. Menasha, Wis., 1960.

The following is based mainly on the authors' abstract. Females of *Musca domestica* L. from a DDT-resistant strain were exposed two or more times at different intervals to sublethal doses of myristyl chloroacetate as deposits in petri dishes. It was found that there is an accumulation of the toxic effects of this substance in *M. domestica*, which is greater the shorter the time that elapses between exposures. From the relation between the accumulation of toxic effects and the time between exposures, it seems probable that detoxification results from at least two processes, proceeding at different rates and regenerating the substances bearing the SH-group blocked by the toxicant [*cf. R.A.E.*, B **48** 57, etc.].

Weinburgh (H. B.) & Fay (R. W.). **Colonization and production of a dieldrin-resistant strain of** *Anopheles quadrimaculatus* **Say.**—*J. econ. Ent.* **53** no. 1 pp. 101–103, 4 refs. Menasha, Wis., 1960.

The following is based mainly on the authors' abstract. A dieldrin-resistant strain of *Anopheles quadrimaculatus* Say was established in the laboratory in 1958 from resistant field material collected from Cleveland, Miss. [*cf. R.A.E.*, B **46** 183]. Although mating was repeatedly observed in cages in a susceptible strain [*cf.* **36** 4], it was never observed in the resistant one; nevertheless, when adults were placed in a cage into which a pig or a hare was introduced as a source of blood, viable eggs were produced. Details of the methods adopted for maintenance of the strain are described. Exposure for one hour to papers impregnated with 0·8–8 per cent. dieldrin in Risella oil killed less than 10 per cent. of the three-day-old females of this strain in 24 hours, and in exposures for 8 hours to 4 per cent. toxicant only half were killed; susceptible females were killed by exposure for one hour to 1·6 per cent. toxicant.

WEIDHAAS (D. E.) & SCHMIDT (C. H.). **Toxicological action of DDT on three species of mosquito larvae.**—*J. econ. Ent.* **53** no. 1 pp. 106–110, 1 fig., 6 refs. Menasha, Wis., 1960.

The following is based largely on the authors' abstract. Fourth-instar larvae from a moderately DDT-resistant strain of *Aëdes taeniorhynchus* (Wied.) and from non-resistant strains of *A. aegypti* (L.) and *Anopheles quadrimaculatus* Say were exposed to suspensions of DDT, labelled with ^{14}C, at 0·04–0·1, 0·001–0·01 and 0·004–0·01 parts per million, respectively, for periods of 2–24 hours, and it was found that the amount of DDT absorbed and the relation of this to mortality varied with the length of exposure and the concentration of toxicant [*cf. R.A.E.*, B **49** 8, etc.]. With *Anopheles*, exposure to a high concentration for a short time gave greater mortality with a smaller absorbed dose than exposure to a low concentration for a long time, but with *Aëdes aegypti* the results were the opposite, and there was a much greater increase in mortality per unit increase in the dose absorbed than with *Anopheles*. The results obtained with *Aëdes taeniorhynchus* were inconsistent. The rate of absorption of DDT decreased for all three species as the exposure period increased. The possible causes of this have not been adequately studied, but it was shown to be due neither to mortality during exposure, because larvae of *Anopheles* that survived a 24-hour exposure to 0·007 p.p.m. DDT showed about the same absorbed dose as those that were killed during the exposure, nor to excretion of DDT or its metabolites, because larvae excreted DDT only when exposed to concentrations above the minimum LC100. Codistillation of DDT [*cf.* next abstract] was considered to be the cause of a slightly lower absorbed dose in larvae of *Anopheles* exposed in open jars than in those exposed in sealed ones, after the first six hours, but was not thought to be the only factor, since the rate of absorption decreased almost as fast in the sealed jars. The resistance of the strain of *Aëdes taeniorhynchus* was not related to absorption of the toxicant, because comparison with results from a more susceptible strain [**48** 22] showed a similar increase in dose absorbed with rising concentration in both strains, but it was thought to be the result of metabolism or innocuous storage in the larvae, or both, since the larvae did not excrete DDT at the normal test concentrations and short exposure periods.

WEIDHAAS (D. E.), SCHMIDT (C. H.) & BOWMAN (M. C.). **Effects of heterogeneous distribution and codistillation on the results of tests with DDT against mosquito larvae.**—*J. econ. Ent.* **53** no. 1 pp. 121–125, 7 refs. Menasha, Wis., 1960.

Experiments were conducted to relate mortality of mosquito larvae to the distribution and loss of DDT (labelled with ^{14}C) under different test conditions, which included tests in open and in closed jars, and the following is based mainly on the authors' abstract of the results. In aqueous suspensions, the concentrations of DDT remaining in suspension after 2 minutes and 24 hours were shown to be about 80 and 30 per cent., respectively, of the theoretical concentration and to vary with the volume of the liquid and the size of the container. This variation resulted from differences in the loss of DDT by codistillation with or without concentration at the water interfaces [*R.A.E.*, B **49** 29], which explained the resulting differences in mortality of mosquito larvae. The mortality of fourth-instar larvae of *Anopheles quadrimaculatus* Say was more influenced by these factors than that of fourth-instar larvae of *Aëdes aegypti* (L.), because of a difference in the dosage-mortality response [*cf.* preceding abstract] and because the larvae of *A. aegypti* try to feed along the container walls, where the DDT accumulates. When fourth-instar larvae of *Anopheles* were exposed to dieldrin, γ BHC (lindane), parathion and malathion, the results indicated that insufficient quantities of these insecticides are lost from the containers to affect mortality under normal test conditions.

RAUN (E. S.) & HERRICK (J. B.). **Organophosphate systemics as sprays and feed additives for cattle grub control.**—*J. econ. Ent.* **53** no. 1 pp. 125–126, 7 refs. Menasha, Wis., 1960.

The following is substantially the authors' abstract. In experiments in 1958–59 on the control of *Hypoderma* larvae in cattle, fenchlorphos (ronnel) was administered in the feed of steers from two localities in Montana and one in Nebraska at the rate of 15 mg. per kg. body weight for seven days or 25 mg. per kg. for six days, and cattle from two of them were sprayed with a 0·5 per cent. suspension or emulsion of coumaphos (Bayer 21/199). There were no differences in the control of *Hypoderma* larvae, weight gain, feed efficiency or carcass grades between the different methods of treatment. Control in cattle from the three places ranged from 76·3 to 98·6 per cent.

METCALF (R. L.) & FUKUTO (T. R.). **O-Ethyl S-2-(ethylthio)-ethyl alkylphosphonothioates as systemic insecticides.**—*J. econ. Ent.* **53** no. 1 pp. 127–130, 1 fig., 13 refs. Menasha, Wis., 1960.

In further tests of alkyl phosphonates and phosphonothioates as insecticides [*cf. R.A.E.*, B **49** 31], some O-ethyl S-2-(ethylthio)ethyl alkylphosphonothioates and closely related compounds were tested topically against *Musca domestica* L. and systemically against insects and mites on leaves [*cf.* A **49** 173].

The contact toxicity of the O-ethyl S-2-(ethylthio)ethyl alkylphosphonothioates to *M. domestica* was found to decrease as the alkyl chain increased from methyl to iso-pentyl, varying with the polar substituent constant, as had occurred in the ethyl p-nitrophenyl alkylphosphonates [*cf.* B **49** 31]; the LD50's of the ethylthioethyl compounds were consistently the higher and the difference between the two series in inhibition of fly-brain cholinesterase was somewhat greater than the difference in toxicity, though of the same general magnitude, suggesting that there is some metabolic enhancement of the toxicity of the ethylthioethyl compounds in the insect and that toxicity and cholinesterase inhibition are closely related. The substitution of double-bonded sulphur for double-bonded oxygen in O-ethyl S-2-(ethylthio)ethyl ethylphosphonothioate to form the dithioate had practically no effect on toxicity, owing to the *in vivo* oxidation of the sulphur, though the reduction in cholinesterase inhibition was considerable. Toxicity was much lower in

O-ethyl O-2-(ethylthio)ethyl ethylphosphonothioate and ethylphosphonate than in any of the S-2-(ethylthio)ethyl compounds, and their anticholinesterase activity was very low.

HOFFMAN (R. A.). **The control of poultry lice and mites with several organic insecticides.**—*J. econ. Ent.* **53** no. 1 pp. 160–162, 7 refs. Menasha, Wis., 1960.

The following is based mainly on the author's abstract. In preliminary tests in Mississippi, dimethoate, dicapthon, malathion, Delnav (2,3-p-dioxane S,S-bis(O,O-diethylphosphorodithioate)), coumaphos (Co-Ral), fenchlorphos (ronnel), Sevin, Monsanto 10561 (the reaction product of s-trithiane-p-chlorobenzenesulphenyl chloride and trimethyl phosphite), Monsanto 12432 (diethyl 1-(dimethoxyphosphinyl)vinyl phosphate), Trithion, Dowco 109 (O-methyl O-(4-tert.-butyl-2-chlorophenyl) methylphosphoramidothioate) and barthrin [6-chloropiperonyl chrysanthemate] were applied, as 0·025–1 per cent. emulsions or wettable powder sprays, to hens with mixed infestations of *Menacanthus stramineus* (Nitzsch), *Menopon gallinae* (L.), *Lipeurus caponis* (L.) and sometimes *Ornithonyssus sylviarum* (C. & F.). All gave good control of the three lice at suitable concentrations, but coumaphos and malathion were the most consistent, 1 per cent. emulsion sprays eliminating all motile forms in 5–7 days, and 0·25 per cent. sprays of these two toxicants were effective against *Ornithonyssus*. Dusts of 5 per cent. malathion, fenchlorphos and Sevin were applied, for control of the lice, to the litter at the rate of 0·5–1 lb. per 42 sq. ft., and of 4 per cent. dicapthon at 0·25–0·5 lb. per 40 sq. ft.; at 0·5 lb. the last two were the most effective, giving complete control, as did the others at 1 lb.

MCALLAN (J. W.) & BROWN (A. W. A.). **The effect of insecticides on transamination in the American cockroach.**—*J. econ. Ent.* **53** no. 1 pp. 166–167, 4 refs. Menasha, Wis., 1960.

In view of the possible importance of insecticides in inhibiting the enzymes that catalyse amino-acid metabolism in insects, the effect of sodium cyanide, sodium orthoarsenate, DDT, malathion, toxaphene and endrin on the glutamate-aspartate transamination reaction was studied in *Periplaneta americana* (L.). In tests *in vitro*, all but sodium orthoarsenate inhibited the enzyme, but only sodium cyanide did so in tests *in vivo*. It is suggested that the inhibition by the organic insecticides *in vitro* was an artifact, due to absorption of protein enzyme by the resulting suspension of insecticide [*cf. R.A.E.*, B **45** 177].

HARVEY (T. L.). **Control of the oriental rat flea with systemic insecticides fed to rats.**—*J. econ. Ent.* **53** no. 1 pp. 167–168, 6 refs. Menasha, Wis., 1960.

Investigations were carried out in Kansas to determine whether adults of *Xenopsylla cheopis* (Roths.) were killed when confined on white rats (*Rattus norvegicus*) that had been treated orally with emulsions or solutions of dimethoate, Dowco 109 (O-methyl O-(4-tert.-butyl-2-chlorophenyl) methylphosphoramidothioate) or fenchlorphos (ronnel) administered in 1 ml. 10 per cent. alcohol at the rates of 25, 200 and 300 mg. per kg. body weight, respectively. Three rats were treated with the insecticides and three with

1 ml. of 10 per cent. alcohol alone; 15 newly-emerged adult fleas were then confined in a plastic container on the back of each rat, and dead fleas were removed and counted daily for three days. Dimethoate was significantly more effective than fenchlorphos or Dowco 109 on the first day after treatment and than fenchlorphos on the second day, when it was also nearly significantly better than Dowco. The numbers of dead fleas on the rats treated with the less effective insecticides were not significantly different from those found on the controls, one and two days after treatment. Three days after, the differences between the treatments were not significant, but the treated rats had significantly more dead fleas than the untreated ones. Two rats, treated with 25 mg. dimethoate per kg. body weight and each exposed to 400 fleas, had 52 and 82 live fleas three days after treatment, whereas two untreated rats, similarly exposed, had 361 and 293 live fleas.

SENGBUSCH (H. G.). **Control of *Myocoptes musculinus* on guinea pigs.**—*J. econ. Ent.* **53** no. 1 p. 168, 4 refs. Menasha, Wis., 1960.

During laboratory experiments, several guineapigs became infested with the Listrophorid mange mite, *Myocoptes musculinus* (Koch), which was taken from suppurating lesions on the animals. The animals were divided into two groups, one of which was submerged in a solution of 0·2 per cent. DMC in 50 per cent. ethanol [*cf. R.A.E.*, B **42** 40], and the other in 2 per cent. Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] [*cf.* **43** 103] with a liquid detergent as wetting agent. No guineapigs under two months old were used. Treatment was given weekly for three weeks, and in both groups the open lesions began to heal after the first application, and the animals gained weight. At the end of the third week, hair grew again on the affected areas. One animal in very poor condition died after the first treatment with Aramite, which, apart from this, was as satisfactory as DMC. To maintain control, the shelves and floors of the cages were disinfected and all other equipment was sterilised; the guineapigs remained free of mites for at least eight months after treatment.

BENNINGTON (E.). **A systemic insecticide and bait for flea and rat control.**—*J. econ. Ent.* **53** no. 1 pp. 169–170, 10 refs. Menasha, Wis., 1960.

Experiments were conducted in 1958 to determine the palatability to rats (*Rattus norvegicus*) of a formulation consisting of 10 per cent. fenchlorphos (ronnel) emulsion concentrate on soy-bean meal in baits and whether the levels of insecticide accepted were effective for the control of rat fleas [*cf. R.A.E.*, B **49** 84]. Baits of coarsely ground maize, alone or with 2·4, 6, 12 or 24 g. of the formulation per lb. were exposed in a warehouse with a large population of *R. norvegicus* for two weeks and replenished three times a week. In later tests, fumarin (an anti-coagulant rodenticide) was added to the fenchlorphos baits at the recommended dose of 0·025 per cent., and baits were exposed in the same way. Rats took baits containing 2·4 g. of the formulation per lb. as readily as untreated ones; the baits with 6 g. were taken well, and those with 12 g. were taken in some areas, but those with 24 g. were avoided. The results obtained with baits containing fumarin were substantially the same, but rats were observed to be poisoned after two weeks' exposure. When given a choice between untreated baits and those treated with fenchlorphos, laboratory rats showed aversion to the latter. When only baits containing fenchlorphos were supplied at rates of 2·4, 6 and 12 g. of the formulation per lb. and the rats were placed in boxes with examples of *Xenopsylla cheopis* (Roths.), the baits were taken well. Few fleas died when the baits contained only 2·4 g. of the formulation, all or nearly all died when they contained 6 g., and all did so when they contained 12 g. All the fleas on rats given baits containing the formulation at 6 g. per lb. and fumarin were killed by the third day, and all the rats were dead after five days. A mixture containing 10 per cent. sugar, fumarin at a reduced dosage and 20 ml. of a commercial liquid smoke and 12 g. of the fenchlorphos formulation per lb. was very palatable to the rats, and when it was given diluted with two parts plain maize meal to rats, in boxes containing fleas, the fleas were dead after three days and the rats after five.

Smyth jr. (T.). **Action of DDT at an insect synapse.**—*J. econ. Ent.* **53** no. 1 pp. 170–171, 1 fig., 11 refs. Menasha, Wis., 1960.

In the experiments described, the application of DDT suspension to the partially desheathed last abdominal ganglion of *Periplaneta americana* (L.) increased the response of the post-synaptic fibre to electrical stimulation of a cercal nerve. This did not occur when the sheath was intact, and it is concluded that the action of DDT must be central, synaptic, rather than on the cercus or cercal nerve.

McKiel (J. A.). **Sensitization to mosquito bites.**—*Canad. J. Zool.* **37** no. 3 pp. 341–351, 19 refs. Ottawa, 1959.

Human reactions to mosquito bites are of two kinds, immediate, the symptoms appearing within a few minutes and disappearing within an hour, and delayed, the symptoms appearing after several hours and persisting for days. An account is given of experiments in which guineapigs and rabbits were sensitised to mosquito bites by injection of mosquito extracts or exposure to biting, and a few rats by the second method. There were immediate reactions, but no delayed ones. Non-sensitised animals, bitten for the first time, showed no toxic symptoms or other reactions of any sort, nor were they sensitive to histamine, and it is concluded that the reactions of the sensitised animals were of an allergic nature [*cf.* *R.A.E.*, B **17** 97; **40** 9]. This view was supported by observations on a young child, in whom there was initially no immediate reaction and only a light delayed one, but, after two seasons' exposure to mosquito bites, a distinct immediate reaction and a more severe delayed one.

It is shown that the sensitising material first appears late in the series of changes that take place within the mosquito pupa and that it is present in males as well as females. It is confined to the region of the head and thorax, presumably forms part of the secretion of the salivary glands and is probably composed of more than one antigenic fraction.

In tests of the specificity of the bite reaction, seven out of ten human volunteers, exposed to bites of *Aëdes aegypti* (L.) and to one or more bites of three other mosquitos, showed some difference in reaction when bitten by the different species and therefore some degree of specificity. In 14 tests in which rabbits sensitised with an extract of either *A. aegypti* or *A. atropalpus* (Coq.) were bitten by mosquitos of a different species (generally of the same genus), cross-reactions were observed, in five instances, with four species of *Aëdes*.

Davies (D. M.). **The parasitism of black flies (Diptera, Simuliidae) by larval water mites mainly of the genus** *Sperchon*.—*Canad. J. Zool.* **37** no. 3 pp. 353–369, 5 graphs, 28 refs. Ottawa, 1959.

The following is largely based on the author's abstract and discussion. Larval water mites, thought to be species of *Sperchon*, were found parasitising adult Simuliids in various parts of Canada in 1946–55, and were studied at Algonquin Park, Ontario, where the species involved was possibly *S. jasperensis* Marshall. All stages of these Sperchonids were found during the summer. The larvae attached themselves to the adult Simuliids as the latter emerged. Parasitism occurred from spring to autumn, reaching a peak in July in Algonquin Park and in August at Baker Lake, North-west Territories. Diurnal changes in parasitism followed the pattern of emergence of the infested species of Simuliid. Larval mites that had doubled in size as parasites regained the water as the female Simuliids were ovipositing. Some Simuliid species were more attacked than others, and females more than males. This appeared to be related to the amount of nutrient stored in the fly. The most important blood-sucking species were the least infested.

Beckel (W. E.) & Atwood (H. L.). **A contribution to the bionomics of the mosquitoes of Algonquin Park.**—*Canad. J. Zool.* **37** no. 5 pp. 763–770, 2 figs., 2 refs. Ottawa, 1959.

The following is based on the authors' abstract. The results of one season's mosquito collecting in Algonquin Park are given, with data on relative abundance, seasonal distribution and habitats of larvae and adults. General correlations between larval distribution on the one hand and vegetation and exposure to light on the other are mentioned. The mosquitos found in the Park comprise three species of *Anopheles*, 17 of *Aëdes*, three of *Culiseta*, two of *Culex*, *Wyeomyia smithii* (Coq.) and *Mansonia perturbans* (Wlk.). Of these 27 species, 21 have been taken biting man, the most common of the latter in order of time of peak abundance (late May–July and August) being *A. communis* (Deg.), *A. punctor* (Kby.), *M. perturbans* and *A. canadensis* (Theo.).

Laird (M.). **Fungal parasites of mosquito larvae from the oriental and Australian regions, with a key to the genus** *Coelomomyces* **(Blastocladiales: Coelomomycetaceae).**—*Canad. J. Zool.* **37** no. 5 pp. 781–791, 8 figs., 16 refs. Ottawa, 1959.

The following is substantially the author's abstract. *Coelomomyces finlayae*, sp. n., and *C. macleayae*, sp. n., are described from larvae of *Aëdes notoscriptus* (Skuse) and a species of *Aëdes* of the subgenus *Macleaya*, respectively, both from Queensland, and *C. stegomyiae rotumae*, var. n., from larvae of a species of the subgenus *Stegomyia* of *Aëdes* from the island of Rotuma near Fiji. *C. cribrosus* and *C. indiana* (the latter attacking *Anopheles subpictus* Grassi) are recorded from new localities, British North Borneo in the first case and Cambodia in the second. *Culex fraudatrix* Theo. is recorded for the first time as a host of *Coelomomyces cribosus*, and *Armigeres obturbans* (Wlk.) as a host of *C. s. stegomyiae*. A key to the 21 adequately characterised species of *Coelomomyces* is followed by a brief discussion of the significance of these fungi, which are lethal to mosquito larvae.

Rageau (J.) & Vervent (G.). **Enquête entomologique sur le paludisme aux Nouvelles-Hébrides.**—[*Tech. Pap. S. Pacif. Comm.*] no. 119, [6+] 34 pp., 5 pls., 3 maps, 55 refs., multigraph. Noumea, 1959.

The literature on *Anopheles farauti* Lav. in the New Hebrides (where it is the vector of malaria and the only known Anopheline [*cf. R.A.E.*, B **44** 191–192]), and on its taxonomic position is reviewed, the egg, larva and adults of both sexes are described, its geographical distribution within the group is set out and its bionomics are summarised from the literature and observations carried out in Vaté and the south of Espiritu Santo from May to July 1958 (the dry season). The larvae pass this season in the marshy edges of streams obstructed by floating or erect vegetation or in permanent swamps. They were never abundant in any one place, but they can develop in a wide variety of environments, both fresh-water and brackish. Resting adults were found only in inhabited huts, particularly in dark, ill-kept ones, and 90 per cent. were females engorged with human blood. As many as 100–150 per hut were seen in one village. The period of maximum abundance is believed to be December–April (the hot and rainy season). Activity was mainly but not exclusively nocturnal. Biting sometimes took place in the middle of the morning. Adults have been found up to 1¼ miles from breeding places. In the laboratory, the egg, larval and pupal stages lasted about 1½, 10 and 1½ days, respectively, and blood-fed females lived up to 51 days. Pairing took place in small cages. A blood-meal seems to be necessary for the completion of the gonotrophic cycle. The only predators of any significance were larvivorous fish.

Dissection of 498 females taken in native huts on Vaté showed an oocyst rate of 5·4 per cent. and no gland infections. Of six females from Espiritu Santo, one had a gut infection. No filarial infections were found. Tests of susceptibility to DDT, γ BHC and dieldrin by the technique of Busvine & Nash [**41** 156] produced no evidence of resistance on either island, and this finding was confirmed by the complete effectiveness of experimental treatment of huts with 0·5 g. dieldrin per sq. metre from a 0·5 per cent. emulsified solution. The possibility of controlling malaria in the New Hebrides by measures against *Anopheles* is discussed. It is concluded that cost, lack of man-power and local indifference make it impossible to rely on them exclusively, but they should be used in conjunction with treatment of the population with anti-malarial drugs. The recommended measures are described.

Colless (D. H.). **Notes on the Culicine mosquitoes of Singapore. VI. Observations on catches made with baited and unbaited trap-nets.**—*Ann. trop. Med. Parasit.* **53** no. 3 pp. 251–258, 1 fig., 7 refs. Liverpool, 1959. **VII. Host preferences in relation to the transmission of disease.** —*T. c.* pp. 259–267, 14 refs.

The following paragraphs are based largely on the author's summaries of these two parts of a series [*cf. R.A.E.*, B **49** 72, etc.].

As it was thought that many mosquitos escape from a trap net in which a man sleeps under a second, smaller net and closes the outer one at intervals, a trap was designed that consists only of a large net with an open door at one end. One or two men generally collect continuously from the walls, but paired tests of a trap used in this way and a similar one containing no human occupants except when catches were made with the door shut revealed that the empty trap took nearly as many mosquitos as the other, accounting for 49, 39 and 48 per cent. of the total catch in three series of tests. The composition of the catches in the two traps and of catches made on man in the open in Singapore, reveals differences in the behaviour of the various species taken. The baited trap appeared to be repellent to females of *Anopheles vagus* Dön. (fed, unfed and gravid), *Mansonia uniformis* (Theo.) (fed), and *Ficalbia luzonensis* (Ludl.) (unfed) and to males of *Culex tritaeniorhynchus* Giles, but males of *M. uniformis* were attracted. It also appeared that *C. tritaeniorhynchus* is attracted to the vicinity of man but is very slow to feed, that *C. pipiens fatigans* Wied. is not strongly attracted but feeds readily, that *M. uniformis* and *Aëdes albopictus* (Skuse) are both strongly attracted and are ready feeders, and that *C. gelidus* Theo. shows little interest in human bait although gravid females sometimes congregated near it, without feeding. The results showed that the catches from baited traps of the type described, when used alone, do not necessarily indicate host preferences, and that unbaited traps may be useful for catching unbiased samples of the mosquitos on the wing at a given time and place, including fed specimens for precipitin tests.

A review of methods of demonstrating host preferences in mosquitos suggested that precipitin tests on mosquitos from unbiased sources are most suitable for field investigations of disease transmission, but that trapping experiments are more useful for the prediction of the course of events in other environments or at different times, particularly if supported by precipitin tests. Results of precipitin tests on 407 mosquitos from practically unbiased sources, mainly the natural resting places in rural and semi-rural areas of Singapore and on others from several sources with varying degrees of bias showed that the blood-meals had been mainly taken from cows, pigs, man and birds. The results of trapping near the first three, and near fowls, are also given. All these hosts are attacked to some degree by many species, but fairly definite patterns of preference can be distinguished, and the species can be grouped according to the host or hosts usually attacked. Those feeding on cow and pig are thought to include most species of *Anopheles* and also *C. tritaeniorhynchus* and *C. gelidus*, of which the first has been found infected with Japanese B encephalitis in Singapore [*R.A.E.*, B **47** 18, etc.] and both in Malaya [**45** 197]. The group normally feeding on man comprised three species of *Aëdes*, including *A. albopictus* Skuse, which feeds from dawn to dusk and is the principal pest species attacking man. *C. p. fatigans* Wied. feeds on both man and birds, attacking at night throughout the island. *Armigeres* spp. and *Mansonia* spp. fed on a variety of hosts including man and, with *C. p. fatigans*, *A. albopictus* and *A. aegypti* (L.), which is purely urban, are the likely transmitters of disease from man to man. The validity and significance of these groupings are discussed, with reference to their possible relation to the transmission of diseases such as Japanese B encephalitis, and it is concluded that several interlocking mosquito-borne cycles may be maintained in various hosts.

CREWE (W.) & GORDON (R. M.). **The immediate reaction of the mammalian host to the bite of uninfected** *Chrysops* **and of** *Chrysops* **infected with human and with monkey** *Loa.*—*Ann. trop. Med. Parasit.* **53** no. 3 pp. 334–340, 1 pl., 8 refs. Liverpool, 1959.

The following is virtually the authors' summary. An immediate wheal reaction, similar to that known to follow the bites of other blood-sucking insects, is shown to occur infrequently in man and monkeys following the bites of *Chrysops*. Two types of immediate reaction are shown to occur, one type following the bites of uninfected flies and a severer type following the bites of flies transmitting the infective larvae of *Loa* of human or simian origin. The reactions are shown probably to be due to previous sensitisation of the mammalian host, in the first case to some substance in the insect's saliva, and in the second to some substance secreted or excreted by the invading parasite. It is shown that in rare instances in man there is a delayed reaction following an infective bite. It sometimes occurs weeks after the bite, and may possibly be caused by the presence of dead filaria larvae that have succumbed to the host's defensive mechanisms.

Dickerson (G.) & Lavoipierre (M. M. J.). **Studies on the methods of feeding of blood-sucking arthropods. II. The method of feeding adopted by the bed-bug** (*Cimex lectularius*) **when obtaining a blood-meal from the mammalian host.**—*Ann. trop. Med. Parasit.* **53** no. 3 pp. 347–357, 5 figs., 12 refs. Liverpool, 1959.

The following is the authors' summary of this second paper of a series [*cf. R.A.E.*, B **49** 53]. The literature relating to direct observations of the methods of feeding of phytophagous and haematophagous Hemiptera is reviewed. A description is given of the feeding process by which *Cimex lectularius* L. obtains its blood-meal from the mammalian host, together with details of the techniques used in the investigation. It is shown that the bed-bug has a flexible fascicle (composed of four stylets—two inner maxillae and two outer mandibles), which probes the host's tissues until it encounters a blood-vessel of suitable calibre, which it then pierces and enters to obtain a blood-meal. During the insect's search for a blood-vessel, small haemorrhages are produced by the probing fascicle, but they are not used as a source of food. *C. lectularius*, like the Triatomine bugs [*loc. cit.*], is a capillary feeder. In a comparison of the mechanism of feeding of the two types of bugs, it is shown that in the Triatomines, the mandibles enter only the superficial layers of the skin of the host, the maxillary bundle penetrating deeply into the tissues, whereas in *Cimex* both the mandibles and the maxillae penetrate deeply into the tissues as a single fascicle.

Baer (H. W.). *Anopheles* **und Malaria in Thüringen.** [*Anopheles* and malaria in Thuringia.]—*Parasit. Schriftenreihe* Heft 12, v+154 pp., 1 fig., 57 graphs, 1 col. fldg. map (in pocket), 9 pp. refs. Jena, G. Fischer Verlag, 1960. Price *DM*.28.10.

After a list of the six Anophelines that occur in Germany, and notes on their distribution, prevalence and habits there and the ability of each to transmit malaria, former knowledge on the Anophelines of Thuringia is outlined, and a detailed account, including much tabulated information, is given of the results of investigations in 1953–55 on the distribution and abundance of the five found in that region, with data on bionomics, overwintering and influence of weather conditions. The group as a whole was very widespread but by no means abundant. The most plentiful representative of it was *Anopheles maculipennis messeae* Flni., which reached its greatest numbers in the river basins, particularly that of the middle Unstrut; *A. m. maculipennis* Mg. (*typicus*) was more widely distributed but less numerous; *A. labranchiae atroparvus* van Thiel was found in four localities in the north and west, *A. claviger* (Mg.), typically though not exclusively an outdoor species, was virtually limited to the river basins and *A. plumbeus* Steph. was taken on man in a few widely scattered localities in the open.

In the second part of the book, the history of malaria in Germany and Thuringia is briefly reviewed, and details are given, largely in tables, of the incidence of the disease in the various Thuringian districts in 1945–51, when 1,692 cases, nearly all caused by *Plasmodium vivax*, were diagnosed, and many more must in fact have occurred. About half of the cases were relapses, and nearly all the others were introduced or of doubtful origin. Only 11 cases were recognised as autochthonous and primary, the last of these occurring in 1949. Relapses and introduced primary cases reached their peak in 1948, and the disease practically died out in 1951. The relation between the distribution of the Anophelines and the malaria cases is discussed. It is concluded that the small numbers of Anophelines, which hardly increased under war conditions, together with the good hygienic and nutritional condition of the people were the chief factors that prevented the post-war establishment of endemic malaria.

JÖRG (M. E.). **Límite sur de la dispersión geográfica de** *Triatoma infestans* **y su infestación por** *Trypanosoma cruzi* **en Argentina.** [Southern limit of the distribution of *Triatoma infestans* and infection with *Trypanosoma cruzi* in Argentina.]—*Bol. Ofic. sanit. panamer.* **42** no. 1 pp. 59–66, 7 maps, 7 refs. Washington, D.C., 1957. (With a summary in English.)

In a survey in Argentina, *Triatoma infestans* (Klug) was found as far south as 44°45′ S. lat. and was infected with *Trypanosoma cruzi* as far as 43°15′, infected examples there being confined to the coastal area.

PAVLOVSKIĬ (E. N.) & SKRȲNNIK (A. N.). **Laboratory observations on the tick** *Ornithodorus hermsi* **Wheeler, 1935.** [*In Russian.*]—*Dokl. Akad. Nauk SSSR* **128** no. 4 pp. 863–864, 5 refs. Moscow, 1959.

In February 1947, three males and eight females of *Ornithodoros hermsi* Wheeler, which is known only in the western United States, were received in the Soviet Union and kept in the laboratory. They reproduced almost immediately, and four generations were reared as a result of occasional feeding in the following 11 years. The ticks were allowed to engorge on guineapigs and white mice at 15–18 and 26°C. [59–64·4 and 78·8°F.]; feeding occurred at any time of the year and was usually completed in 30–40 minutes, though the adults sometimes required 1·5–2 hours. One male and one female of the original batch were still alive in 1958; they had fed last on 3rd December 1957, and the female laid viable eggs on 31st December. Such long life had not previously been recorded for this species.

At 26°C., the females oviposited at any time of the year, 13–30 days after feeding, laying batches of up to 150 eggs each [*cf. R.A.E.*, B **24** 207]. The larvae hatched in 15–21 days and moulted to the nymphal stage in 13–23 days. The nymphs gave rise to adults after 2–4 moults, usually after three, and the four nymphal instars lasted 14–27, 14–22, 17–63 and 83–100 days, respectively. The periods required for development from the beginning of oviposition to adult emergence from nymphs in the second, third and fourth instars were 56–93, 73–156 and 156–258 days, respectively. The minimum period from larval feeding to the hatching of the larvae of the following generation was four months. The nymphs did not always moult after each feed, and some individuals remained in the nymphal stage for three years. At room temperature and with long periods between feeds, the nymphal stage was prolonged to seven years. Without food, the larvae survived for 3–4 months, first-instar nymphs for 5–7 months at 26°C. and almost a year at 15–18°C. and third-instar nymphs and adults for up to three years.

When 16 groups of *O. hermsi* in the larval and the nymphal stages were fed on animals infected with spirochaetes transmitted by five other species of the genus and then on healthy animals, no transmission was effected, and it is concluded that *O. hermsi* transmits only the spirochaetes peculiar to it [*cf.* **23** 221].

WORLD HEALTH ORGANIZATION. **Specifications for pesticides. Insecticides, rodenticides, molluscicides, herbicides, auxiliary chemicals, spraying and dusting apparatus.**—2nd edn., 523 pp., 31 figs., refs. Geneva, 1961. Price £2 10*s*.

This is a second and considerably enlarged edition of a manual of specifications, drawn up by Expert Committees on Insecticides of the World Health Organization, for chemical products and preparations of them intended to be used against insect and other vectors and reservoirs of diseases of man and for the equipment necessary to apply these products. It contains the information in the first edition [*R.A.E.*, B **45** 137], some of it revised, a new section on herbicides, one on oils, with and without added insecticides, and insecticide-impregnated granules for use as mosquito larvicides, and various annexes grouping together analytical procedures common to several specifications and routine test methods that are alternative to the analytical methods required by the specifications. Additional chemicals and formulations for which specifications are given are technical Chlorthion and trichlorphon (Dipterex) and emulsion concentrates containing them, a water-dispersible powder containing Chlorthion, dusting powders of diazinon and malathion, and three auxiliary chemicals, sucrose and technical sodium benzoate and tetrasodium ethylenediamine tetra-acetate.

PAPERS NOTICED BY TITLE ONLY.

ADAM (J. P.) & HAMON (J.). **I. Présence en Côte d'Ivoire de** *Anopheles paludis* **Theo. 1900 et** *A. obscurus* **var.** *nowlini* **Evans 1932. II. Comparaison des terminalia des espèces éburnéennes du sous-genre** *Anopheles*.—*Ann. Parasit. hum. comp.* **33** no. 4 pp. 509–512, 1 fig., 5 refs. Paris, 1958.

RAGEAU (J.). **La répartition géographique des moustiques en Nouvelle-Calédonie et dépendances avec des clés pour leur identification.**—[*Tech. Pap. S. Pacif. Comm.*] no. 117, [3+] 18 pp., 1 fldg. map, 27 refs., multigraph. Noumea, 1958.

SCHULZE (W. G.). **Experimentelle Untersuchungen über den Einfluss der Luftfeuchtigkeit auf die Vorzugstemperatur von medizinisch wichtigen Schmeissfliegen- und Stechmückenarten (Calliphoridae und Culicidae).** [Experimental investigations on the influence of atmospheric humidity on the preferred temperature of medically important blowflies (*Calliphora vicina* R.-D. (*erythrocephala* (Mg.)) and *Lucilia sericata* (Mg.)) and mosquitos (*Aëdes aegypti* (L.)).]—*Z. angew. Ent.* **44** pt. 1 pp. 64–101, 17 graphs, 30 refs. Hamburg, 1959. (With a summary in English.)

DOSS (M. A.), HUMPHREY (J. M.) & SEGAL (D. B.). **Index-catalogue of medical and veterinary zoology. Supplement 10. Authors: A to Z.**—[1+] 357 pp. Washington, D.C., U.S. Dep. Agric., 1960. Price $1.25 (from Supt. Documents). [*Cf. R.A.E.*, B **48** 100.]

Davidson (G.). **Studies on insecticide resistance in Anopheline mosquitos.** —*Bull. World Hlth Org.* **18** no. 4 pp. 579–621, 5 graphs, 26 refs. Geneva, 1958. (With a summary in French.)

The following is largely based on the author's synopsis. An account is given of observations on the susceptibility to various insecticides of *Anopheles gambiae* Giles in Nigeria, Tanganyika and Mauritius, *A. sundaicus* (Rdnw.) in Java and *A. stephensi* List. in Saudi Arabia and of laboratory colonies of these species in London. The techniques used in assessing the susceptibilities of both adults [*cf. R.A.E.*, B **41** 156; **47** 86] and larvae are described, and the effects of species, conditions of rearing, age, sex, feeding and ovarian development on susceptibility are discussed. The development of vigour tolerance [**47** 72] in *A. stephensi* was demonstrated in the form of a low degree of resistance resulting from continuous selection by DDT in the laboratory of a presumably homogeneous susceptible strain from Delhi. Specific, monofactorially-inherited resistance is then described as witnessed in *A. gambiae* [**45** 68–69], which shows a high degree of resistance to dieldrin and cross-resistance to the related cyclodiene compounds and γ BHC but remains susceptible to DDT, and in *A. sundaicus* [**47** 86], which shows moderate resistance to DDT and cross-resistance to DDT analogues but remains susceptible to dieldrin and γ BHC. The single gene involved is partly dominant in the first case, the hybrid between resistant and susceptible strains showing a moderate degree of resistance, and virtually recessive in the second, the hybrid being for all practical purposes susceptible. The discriminating-dosage technique for distinguishing the phenotypes in these species [*cf.* **45** 69; **47** 86] is described. In *A. gambiae*, most male hybrids arising from crosses between resistant females and susceptible males and sometimes those arising from the reciprocal cross were sterile, and a relation can be detected in this species between resistance and sterility, which was not observed in *A. sundaicus*.

The general principles emerging from the observations are discussed, with reference to resistance in other species of *Anopheles* and in house-flies [*Musca domestica* L.]. Genetical resistance to both groups of toxicants is seen in *M. domestica* [**44** 111], and since flies resistant to one group readily become resistant to the other, producing multi-resistant strains, it would appear that the two genes co-exist in the populations. A method is proposed of detecting true monofactorial resistance in Anophelines in the field by establishing the LD100 of the insecticide for a susceptible population, exposing mosquitos of the suspected resistant population to this dosage, breeding from the surviving fertilised females and exposing their progeny to the same dose. If resistance is present and is of the type described for *A. gambiae*, these offspring should show 100, 75 or 50 per cent. survival according to whether both parents were resistant or hybrid forms, or were hybrid females previously mated with susceptible males. If resistance is of the type described for *A. sundaicus*, the only survivors would be homozygous resistants, and since resistance is virtually recessive, the offspring of such survivors that had previously mated with homozygous susceptibles would be apparently susceptible; only by the production of an F_2 generation from these offspring could homozygote resistants, shown by a 25 per cent. survival at the discriminating dosage, be detected. If an original survivor had mated with a heterozygote, the mortality among the offspring would be 50 per cent. and if with a homozygote resistant, nil.

Liu (S. Y.). **A summary of recent insecticidal tests on some insects of medical importance in Taiwan.**—*Bull. World Hlth Org.* **18** no. 4 pp. 623–649, 9 figs., 7 refs. Geneva, 1958. (With a summary in French.)

DDT has been in use in Formosa since 1948, and BHC was also used in 1955 and 1956, in some areas. In this paper, an account is given of tests carried out in 1956 and 1957 to investigate the possible appearance of resistance to DDT in six species of *Anopheles* (*A. minimus* Theo., *A. hyrcanus sinensis* Wied., *A. maculatus* Theo., *A. ludlowii* (Theo.), *A. tessellatus* Theo. and *A. subpictus indefinitus* (Ludl.)) and also in *Culex pipiens fatigans* Wied., *Aëdes aegypti* (L.) and *Musca domestica vicina* Macq. and resistance to BHC in *Cimex hemipterus* (F.). Among the Anophelines, which were tested by the method of Busvine & Nash [*R.A.E.*, B **41** 156], *Anopheles minimus*, the main malaria vector on the island [**46** 215], was the most susceptible to DDT, the LC50's of the various strains tested ranging from 0·09 to 0·22 per cent. Strains of *A. hyrcanus sinensis*, a secondary vector [**46** 216], had LC50's ranging from 1·57 to 8·5 per cent., all higher than those of any of the other species. Some differences between the LC50's for the various strains of *A. minimus* were significant, as were some between those for the various strains of *A. h. sinensis*, but it is shown that further work is needed before it can be concluded that the resistance had been acquired.

Larvae of *Culex p. fatigans* reared from eggs collected from an area that had been extensively treated with DDT larvicide were 50–100 times as tolerant of DDT as those of two laboratory colonies. No larvae of *Aëdes aegypti* were found in August 1956, despite a thorough search, in townships in which this species had once been plentiful and in which houses had been sprayed with DDT at least once. Larvae of a local strain from a city that had not been sprayed with DDT and a normally susceptible laboratory strain were found to have LC50's of 0·07 and 0·05 parts per million DDT, respectively. Larvae of two laboratory colonies of *M. d. vicina*, one from a township that had been sprayed with DDT in two successive years and one established before treatment had begun in the village from which it originated, showed about 35- and 20-fold resistance as compared with a susceptible laboratory colony of typical *M. domestica* L. from England [*cf.* **42** 27]. No significant difference was found in the susceptibility to γ BHC of two populations of *Cimex hemipterus* from two villages in which the bugs had increased after an initial decline following treatment with mixed sprays that included BHC for the control of DDT-resistant bugs, and of a third from a locality in which no BHC had been used.

Busvine (J. R.) & Coker (W. Z.). **Resistance patterns in DDT-resistant** *Aëdes aegypti.—Bull. World Hlth Org.* **18** no. 4 pp. 651–656, 1 graph, 7 refs. Geneva, 1958. (With a summary in French.)

The following is almost entirely based on the authors' synopsis and summary. Colonies of three strains of *Aëdes aegypti* (L.) resistant to DDT were obtained from Haiti, Trinidad and Malaya and reared beside a normal colony for several months without exposure to DDT. No considerable change in their degree of resistance was observed. Fourth-instar larvae of the three strains had LC50's 340, 120 and six times that of the normal one, respectively, though the resistance of the adults was comparatively slight. From the relative resistance of the larvae to a series of DDT analogues, characteristic resistance spectra were obtained. The resistance of all strains was comparatively high to DDT, DDD and bromo-DDT and low to methoxy-DDT (methoxychlor), dianisyl neopentane [1,1-di(p-methoxyphenyl)-2,2,2-trimethylethane] and fluoro-DDT. None of the strains was resistant to dieldrin. The first three analogues are dehydrochlorinated more easily under the action of an alkali than the last three, but this may be coincidence.

DMC, which antagonises the dehydrochlorination mechanism in house-flies [*Musca domestica* L.] [*R.A.E.*, B **47** 50, etc.] had no synergistic effect on DDT used against larvae of the Trinidad or Malayan strains. The two colonies from the West Indies showed a similar type of resistance that was rather different from the lower resistance of the Malayan strain and this agrees with the results of genetical experiments by one of the authors [**48** 237].

WHARTON (R. H.). **Dieldrin resistance in** *Culex pipiens fatigans* **in Malaya.**—*Bull. World Hlth Org.* **18** no. 4 pp. 657–665, 1 graph, 10 refs. Geneva, 1958. (With a summary in French.)

Resistance to insecticides in *Culex pipiens fatigans* Wied. has been reported from Penang, where a tenfold resistance to both BHC and dieldrin developed after two years' use of BHC [*R.A.E.*, B **44** 164], and from Singapore, where larval control became unsatisfactory after six months' use of an emulsion containing dieldrin, and laboratory experiments confirmed that active resistance to dieldrin had been acquired. In the present paper, the finding of two further strains resistant to dieldrin and BHC in Malaya is reported. In East Pahang, house-spraying with dieldrin at 100 mg. per sq. ft. in an isolated Malay community resulted in the development, in two and a half years, of highly localised 100-fold resistance to dieldrin in both adults and larvae and about 20-fold resistance to γ BHC in larvae, while resistance to DDT was slight. A few tests with members of a strain derived from unsprayed houses in a fairly large town where there had been casual but no organised spraying of houses, some fogging of vegetation near houses with dieldrin and no use of DDT, dieldrin or BHC in routine larvicidal operations, indicated that the adults were resistant to dieldrin and that the larvae had developed 60-fold resistance to dieldrin, sevenfold to γ BHC, and possibly slight resistance to DDT.

FLOCH (H.) & FAURAN (P.). **Sensibilité aux insecticides chlorés des larves de** *Culex fatigans* **et d'***Anopheles aquasalis* **en Guyane française.**—*Bull. World Hlth Org.* **18** no. 4 pp. 667–673, 9 refs. Geneva, 1958. (With a summary in English.)

The spraying campaigns by means of which *Aëdes aegypti* (L.) was eradicated from French Guiana and *Anopheles darlingi* Root suppressed in the inhabited areas [*R.A.E.*, B **44** 200] had no permanent effect on *Culex pipiens fatigans* Wied. [**44** 201], the vector of *Wuchereria bancrofti*, or on *A. aquasalis* Curry, a potential malaria vector [**34** 58–59; **44** 200] considered to be responsible for a few indigenous cases seen in recent years. As resistance to the insecticides used (DDT in houses, and BHC in outbuildings and as a larvicide) was suspected to have developed in these two species, larvae of *C. p. fatigans* from Cayenne and of *A. aquasalis* from a marsh a few miles away were exposed to three chlorinated hydrocarbons in standard tests [**47** 155]. The results of the observations, given in tables, showed that the Cayenne population of *C. p. fatigans* tolerated 20 times the normal concentrations of γ BHC and dieldrin; the LC50's for these compounds were 0·6 and 0·15 parts per million, respectively. The LC50 of DDT (0·2 p.p.m.) was 5–10 times that normally required. The resistance to BHC and dieldrin, as well as the marked reduction in the susceptibility to DDT, appears to be due to the use of BHC as a larvicide. *A. aquasalis* had remained susceptible, the LC90 being less than 0·004 p.p.m. for all three insecticides and about 0·002 p.p.m. for DDT and BHC, in spite of the use of DDT against the adults for nine consecutive years. The persistence of this species is undoubtedly due to the fact that the adults rest mainly outdoors and feed largely on animals.

ASCHER (K. R. S.). **Preferential knockdown action of cetyl bromoacetate for certain laboratory-reared resistant strains of houseflies.**—*Bull. World Hlth Org.* **18** no. 4 pp. 675–677, 12 refs. Geneva, 1958.

After cetyl bromoacetate had been found to cause greater knockdown of resistant than of susceptible strains of *Musca domestica domestica* L. and *M. d. vicina* Macq. [*R.A.E.*, B **48** 58], its action on adults of four strains of *M. d. domestica* that had been developed in the laboratory by selection with various insecticides applied to each generation and on one normally susceptible and one almost susceptible strain was studied. Exposure was by continuous tarsal contact for two hours with deposits on glass from acetone solutions. One of the selected strains was highly DDT- and multi-resistant, one was chlordane-resistant, one had been derived from the last by selection with chloroacetic acid for 80 generations and one had been selected with diazinon. The last strain showed a high degree of resistance to DDT, but the chlordane-resistant strain and its derivative showed practically none. Cetyl bromoacetate caused almost equal knockdown of these four strains, whether they were resistant to DDT or not [*cf.* **44** 15], and considerably less knockdown of the normal ones. Although it appears likely that bromoacetic acid acts on insects by inhibiting triosephosphate dehydrogenase [*cf.* **45** 139], there was no difference in the triosephosphate-dehydrogenase activities of whole-fly extracts of the chlordane-resistant and one of the normally susceptible strains.

MCLINTOCK (J.), ZEINI (A.) & DJANBAKHSH (B.). **Development of insecticide resistance in body lice in villages of north-eastern Iran.**—*Bull. World Hlth Org.* **18** no. 4 pp. 678–680, 1 ref. Geneva, 1958.

Typhus is widespread in Persia but of low endemicity, and epidemics that may involve only a few villages or the whole country break out from time to time. Studies on the control of the vector louse [*Pediculus humanus humanus* L.] were made in north-eastern Persia in 1955–57 in 28 villages in which from 25 to almost 100 per cent. of the population were infested. In the first season, dusting with 10 per cent. DDT or 1 per cent. γ BHC 2–4 times at intervals of one or two months, first at 17 g. per person and later at about 50 g., failed to give satisfactory control, whether treatment was given to a random sample of the inhabitants or to all who could be reached; no resistance was induced in the lice. In 1956, 73–100 per cent. of the people in individual villages and also bedding, clothing and carpets were dusted with 10 per cent. DDT or 1 per cent. γ BHC at 51 g. per person either once a week for four weeks, four times at fortnightly intervals or once a week for three weeks and then once a month for five months. Inspections were made monthly. The first schedule most rapidly reduced the percentage of people infested. The third schedule maintained the percentage infested at a low level in only one of the four villages concerned. DDT reduced the percentage of people infested slightly more than BHC. In one village that had been completely treated with BHC in 1955, a susceptibility test after the last dusting in 1956 showed that only about 61 per cent. of the lice were killed or seriously affected by exposure to 0·25 per cent. BHC. Tests in 1957, in which lots of 10–20 recently fed adult lice were exposed under petri-dish lids for 24 hours to pieces of cloth dusted with insecticide showed that BHC-resistant strains developed in villages that had been dusted by the first and third schedules but not in those dusted by the second. Resistance did not develop where DDT had been used, but in two villages there were indications that louse populations dusted with BHC developed some resistance to DDT also. It is therefore recommended that BHC dust should not be used for louse control in Persia.

LAIRD (M.). **Susceptibility of adults of a Malayan strain of** *Culex pipiens fatigans* **Wiedemann to DDT and dieldrin.**—*Bull. World Hlth Org.* **18** no. 4 pp. 681–683, 7 refs. Geneva, 1958.

Engorged females of *Culex pipiens fatigans* Wied. were found on 7th March 1957 resting in sheltered places in premises at Kuala Lumpur that had been sprayed monthly with DDT since late 1945 and once with dieldrin in the autumn of 1955. Young females from a colony established at Singapore from them were tested for resistance to DDT and dieldrin by Busvine's method [*R.A.E.*, B **47** 86, etc.] a few hours after their first blood-meal, and the LC50's were found to be 1·4 per cent. for dieldrin and well over 5 per cent. for DDT [*cf.* **43** 169]. At concentrations of 0·5–2 per cent. DDT, mortality was approximately steady at about 25 per cent., which indicated heterogeneity. Wharton found that resistance to dieldrin in this mosquito develops rapidly, all adults from an area that had been sprayed five times surviving exposure to 4 per cent. toxicant; C. P. Collins recorded that control of larvae deteriorated within four months of the replacement of DDT by dieldrin at the Singapore Naval Base. In view of these findings, a return to measures of sanitation for the control of *C. p. fatigans* at Kuala Lumpur and in other places where chlorinated hydrocarbons are no longer effective is considered desirable.

WHARTON (R. H.). **Penang BHC-resistant strain of** *Culex pipiens fatigans.*—*Bull. World Hlth Org.* **18** no. 4 p. 684, 1 ref. Geneva, 1958.

The strain of *Culex pipiens fatigans* Wied. from Georgetown, on Penang Island, Malaya, that had lost much of its resistance to BHC after passing through ten generations without exposure to insecticides [*R.A.E.*, B **44** 164] was found to have lost resistance completely when larvae of the 43rd unexposed generation were tested in October 1957.

LABRECQUE (G. C.), WILSON (H. G.), BOWMAN (M. C.) & GAHAN (J. B.). **Studies on the development of resistance to DDT and malathion in house flies.**—*Florida Ent.* **42** no. 2 pp. 69–71, 5 refs. Gainesville, Fla., 1959.

Laboratory studies were begun in Florida in 1956 to determine the effect of selection with an organophosphorus compound and a chlorinated hydrocarbon, used individually, alternately or in combination, on the rate of development of resistance. Four experimental colonies of *Musca domestica* L. were formed by exposing adults of each generation of the regular susceptible colony to contact sprays in a wind tunnel [*cf. R.A.E.*, B **47** 85]. The colonies were treated with malathion, DDT, a combination of DDT and malathion, or DDT and malathion alternately in successive generations. After treatment, flies were kept for 24-hour mortality counts, and survivors were released in a cage containing oviposition medium. The progress of resistance was followed by exposing females 4–5 days old from the various generations up to the 32nd to sprays of DDT or malathion in wind tunnels. After treatment, the flies were transferred to cages provided with sugar solution, and mortality was recorded after 24 hours. The degree of resistance was estimated as the ratio of the LC50 of each experimental colony to that of the regular colony. After 30–32 generations, resistance to DDT was lower in the colony selected with DDT and malathion alternately than in those selected with DDT or a combination of DDT and malathion, but had nevertheless attained a high level, and even the colony selected with malathion had developed 10- to 30-fold resistance to DDT. Resistance to malathion varied from two- to sixfold in different generations. As the colony selected with malathion (alone) showed resistance, the extent of DDT dehydrochlorination to DDE was determined by exposure of adult flies to glass surfaces bearing deposits of 3·5 mg. p,p′DDT per sq. ft. for five hours, and their analysis for internal DDT and DDE. The presence of an average of 26·2 μg. DDT and 89·5 μg. DDE per 100 flies indicated a high rate of dehydrochlorination of DDT to DDE in this strain of *M. domestica.*

DANARAJ (T. J.), SCHACHER (J. F.) & COLLESS (D. H.). **Filariasis in Singapore.**—*Med. J. Malaya* **12** no. 4 pp. 605–612, 14 refs. Singapore, 1958.

Infection with *Wuchereria bancrofti* on the Malayan mainland is usually found only in immigrants [*cf. R.A.E.*, B **27** 11], and local transmission seldom occurs. It has hitherto been generally supposed that cases observed in Singapore were also introduced. However, in the limited survey described in this paper, infection was found to be endemic there. Examination of 902 blood samples showed that 50 contained microfilariae, all of *W. bancrofti*, in small to moderate numbers. None of the people concerned showed signs of filariasis. Of 80 patients with clinical signs of filariasis, examined in 1957–58, 37 were found to have microfilariae in the blood. Again, all were of *W. bancrofti*. Analysis of the residential histories of these 80 patients and the 50 infected persons found in the survey showed that 2, 12 and 8 of the 75 Indians, 42 Chinese and 12 Malays had lived in Singapore continuously since birth and 18, 21 and 2 others, respectively, had lived there continuously for at least ten years. It is concluded that the disease was endemic in origin in those born on the island, and almost certainly so in the others. Dissection of 1,152 females of *Culex pipiens fatigans* Wied. from houses or traps revealed the presence of larvae of *W. bancrofti* in 1·6 per cent. and of infective larvae in 0·9 per cent.

SURTEES (G.). **On the distribution and seasonal incidence of Culicine mosquitoes in southern Nigeria.**—*Proc. R. ent. Soc. Lond.* (A) **34** pt. 7–9 pp. 110–120, 30 refs. London, 1959.

The following is based on the author's summary. Investigations on mosquitos other than Anophelines, carried out in an isolated village in south-western Nigeria in 1956–57, comprised a survey of the natural larval habitats and studies on the distribution and seasonal incidence of the major species.

The former showed that *Aëdes aegypti* (L.) was largely confined to domestic water containers in the village, *A. longipalpis* (Grünb.) to tree holes in the rain-forest, *Eretmapodites chrysogaster* Grah. to husks in a cacao plantation, *Harpagomyia taeniarostris* Theo. to leaf axils and *E. penicillatus* Edw. to snail shells. Other species were less restricted. There was shown to be a succession of species extending from the village through scrub into the forest, consisting of *A. aegypti*, *A. apicoargenteus* (Theo.), *Culex nebulosus* Theo., *Toxorhynchites* (*Megarhinus*) *brevipalpis* Theo., *E. chrysogaster*, *C. albiventris* Edw., *A. longipalpis* and *A. simulans* (Newst. & Cart.). The numbers of larvae increased at the beginning of the rainy season, declined in the mid-rainy season (June–July) and rose again in August, before a final drop at the end of the rainy season. The coincidence between the natural classification of breeding sites and the species found in them, as postulated by Shannon [*R.A.E.*, B **19** 103], is discussed and is shown to exist for only a few of the species encountered. The pattern of distribution in the area is considered to be determined by a combination of factors, including those relating to the habitats of the larvae and the food sources of the adult females. It is further suggested that the mid-year drop in numbers is a population-density reaction, since it was found that, under controlled conditions, increase in the density of the larvae leads to higher mortality and a longer developmental period.

Smith (A.) & Weitz (B.). **The feeding habits of** *Anopheles gambiae*, **with particular reference to subsidiary hosts.**—*Ann. trop. Med. Parasit.* **53** no. 4 pp. 414–415, 5 refs. Liverpool, 1959.

The habits of females of *Anopheles gambiae* Giles when feeding on man and cattle have been fully examined in the Pare-Taveta area of Tanganyika and Kenya [*R.A.E.*, B **47** 111; **48** 178–179], and the extent to which they feed on other hosts was studied in swamp villages in the South Pare Mountains, Tanganyika, in 1954–55. Examination by precipitin test of the blood-meals of females collected from huts showed that the percentages that had taken single feeds on man, cattle, sheep or goat, dog and domestic fowl were 40, 47, 4·6, 1·3 and 0·7, respectively. Although sheep, goats and fowls are numerous in the swamp villages, they are penned at night and are less easily accessible than cattle and men, and this may partly account for the small number of feeds made on them. However, the fact that all the females (3·83 per cent. of the total) that had taken multiple feeds had fed once on man or cattle suggests that sheep, goats, dogs and fowls were less attractive and that the mosquitos interrupted feeds on them to complete the meal on man or cattle. Of 188 females from box shelters [**42** 119] situated round an enclosure containing 75 sheep or goats and seven calves, 144 had fed on cattle, 30 on sheep or goat, 6 on man, one on man and cattle and two on cattle and sheep or goat. Though mosquitos were observed to alight on goats and make probing movements, none of the many caught on the animals had taken a full blood-meal.

Williams (P.). **The effect of atmospheric pressure on** *Aëdes aegypti* **exposed to** *Dirofilaria immitis* **and on** *Glossina morsitans* **exposed to** *Trypanosoma rhodesiense* **or** *T. congolense*.—*Ann. trop. Med. Parasit.* **53** no. 4 pp. 451–464, 6 figs., 13 refs. Liverpool, 1959.

Laboratory experiments are described in which females of *Aëdes aegypti* (L.) that had fed on a dog with microfilariae of *Dirofilaria immitis* in its blood and adults of *Glossina morsitans* Westw. that had fed on a guineapig infected with *Trypanosoma rhodesiense* were maintained at atmospheric pressures corresponding to those found at sea-level (29·92 or 29·97 in. mercury), at 1,300 ft. above sea-level (28·55 in. mercury) and at 18,500 ft. above sea-level (15·72 in. mercury) and adults of *G. morsitans* that had been similarly exposed to *T. congolense* were maintained at pressures of 29·92 and 15·72 in. The results showed that reductions in atmospheric pressure to the levels used in the experiments did not affect the insects adversely, and there was no evidence that they altered the course of development of the parasites in the insects.

DICKERSON (G.) & LAVOIPIERRE (M. M. J.). **Studies on the methods of feeding of blood-sucking arthropods. III. The method by which** *Haematopota pluvialis* **(Diptera, Tabanidae) obtains its blood-meal from the mammalian host.**—*Ann. trop. Med. Parasit.* **53** no. 4 pp. 465–472, 3 figs., 18 refs. Liverpool, 1959.

The following is virtually the authors' summary of this third paper of a series [*cf. R.A.E.*, B **49** 90, etc.]. The literature on the method of feeding of *Haematopota*, *Tabanus* and *Chrysops* spp. is briefly summarised. It is shown that, hitherto, workers have dealt only with the behaviour of the fly on the skin of the host as it is taking up its blood-meal, with histological studies of the disposition of the mouth-parts in the tissues and of the lesions produced and with the morphology of the head and mouth-parts [*cf.* **42** 167, etc.]. The feeding process by which *H. pluvialis* (L.) obtains its blood-meal from the mammalian host is described, mainly from direct observations on the movements of the mouth-parts of the insect in the tissues of the living host. It is shown that the fascicle of *Haematopota* penetrates the host's skin by means of a thrusting action, the mandibles and maxillae alone being responsible for the cutting and laceration of the tissues. The mandibles move with a scissor-like action, while the maxillae move up and down; the combined movements of mandibles and maxillae result in the rupture of small and large blood-vessels, from which a pool of blood is produced in the tissues. The fly feeds from this pool, into which the tip of the fascicle is dipped. *Haematopota* may thus be described as a true pool feeder.

ROGOFF (W. M.), KOHLER (P. H.) & DUXBURY (R. N.). **The** *in vivo* **activity of several systemic insecticides against cattle grubs in South Dakota.**—*J. econ. Ent.* **53** no. 2 pp. 183–187, 10 refs. Menasha, Wis., 1960.

Tests were carried out in 1954–59 on the effectiveness of several insecticides for the systemic control of larvae of *Hypoderma lineatum* (Vill.) and *H. bovis* (Deg.) in cattle in South Dakota [*cf. R.A.E.*, B **49** 10, 12], and the following is mainly the authors' abstract of the results. Fenchlorphos (ronnel), applied as a drench or bolus at about 110 mg. per kg. body weight gave 99 per cent. control or more, except where the level of infestation averaged less than one larva per head. Dimethoate, applied orally and intramuscularly at 15 mg. per kg. body weight, gave 94 per cent. control, but caused as much as 56 per cent. depression of cholinesterase activity and a slower gain in weight at least initially. Sprays of 0·75 per cent. Dowco 109 [O-methyl O-(4-tert.-butyl-2-chlorophenyl) methylphosphoramidothioate] gave complete control and caused no detectable depression of cholinesterase, but when sprayed at 0·5 per cent. over the entire body in one test or on the back alone in another, this compound gave 27 and 72–76 per cent. control, respectively. When cattle were sprayed partially or completely with coumaphos (Bayer 21/199) wettable powder or emulsion, the percentage control ranged from 91–97 to below 65 when the concentration was 0·5 per cent., the results not being directly related to the degree of coverage or formulation. At 0·25 per cent., it was 43 per cent. or less. Nicarbazin (a complex of 4,4′-dinitrocarbanilide and 2-hydroxy-4,6-dimethyl pyrimidine) gave only 26 per cent. control when administered in four monthly oral doses, each of 25 mg. per kg. body weight, but 65 and 86 per cent. in single oral doses of 125 and 250 mg. per kg. Six other materials gave 27 per cent. control or less.

Grayson (J. McD.). **Laboratory selection of normal and chlordane-resistant German cockroaches for resistance to malathion and diazinon.**—*J. econ. Ent.* **53** no. 2 pp. 200–203, 3 figs., 11 refs. Menasha, Wis., 1960.

In experiments on selection for resistance to malathion and diazinon, nymphs of *Blattella germanica* (L.) from chlordane-resistant and normal strains were exposed to deposits of emulsified solutions of these two insecticides on tempered Masonite panels and on the inner surfaces of the glass jars containing them. The basis of selection was survival of treatments that gave more than 50 per cent. kill in the parental, F_1 and F_2 generations, more than 65 per cent. in the F_3 and F_4 generations of the normal strain and the F_3, F_4 and F_5 generations of the chlordane-resistant strain, and more than 80 per cent. kill thereafter. At intervals, adults of both the malathion- and the diazinon-selected strains were exposed for one hour to the appropriate insecticide, applied in Risella oil to a filter paper. Counts were made of dead and moribund cockroaches after one and three days. Adults of the strain selected with malathion were also exposed to this compound on Masonite panels in glass jars that had been similarly treated. At LC50 and LC90 levels, females of the F_6 generation of the normal strain were, respectively, 6·9 and 1·5 times as resistant to malathion as the original population when exposed on filter paper, and 13·1 and 17·8 times as resistant when exposed on panels; females of the chlordane-resistant strain in the F_7 generation were 9·4 and 1·4 times as resistant to malathion when exposed on filter paper and 42·9 and 24·3 times as resistant when exposed on panels. The general pattern of resistance of both males and females was similar. Both sexes of the chlordane-resistant strain were originally more resistant to malathion than those of the normal strain, but resistance developed more rapidly in the former, especially in the males, when placed under selection pressure from malathion. Selection for resistance to diazinon produced slight trends toward steeper regression lines after six or seven generations, but the selected strain exhibited no detectable resistance to diazinon.

Casida (J. E.), Augustinsson (K. B.) & Jonsson (G.). **Stability, toxicity, and reaction mechanism with esterases of certain carbamate insecticides.**—*J. econ. Ent.* **53** no. 2 pp. 205–212, 2 graphs, 33 refs. Menasha, Wis., 1960.

The following is based on the authors' abstract. Details are given of laboratory experiments in which 30 N-alkyl- and N,N-dialkylcarbamates, including Sevin, Isolan, Pyrolan and dimetan, were compared for their stability, activity as inhibitors of acetyl- and butyrylcholinesterase and toxicity to *Musca domestica* L. and mice. A distinctive structural specificity, unrelated to stability, was observed for each type of biological activity. The compounds varied greatly in their inhibitory specificity for acetyl- and butyrylcholinesterase and in the rate of attaining an equilibrium of cholinesterase, carbamate and acetylcholine during assay. Plasma albumin was found to hydrolyse p-nitrophenyl N-alkylcarbamates, whereas plasma cholinesterase or arylesterase had little effect, and chymotrypsin and human plasma butyrylcholinesterase did not react with the carbamates as they did with the acetates, ethyl carbonates and dialkyl phosphates derived from the same enols. These results indicate that competition rather than carbamoylation is the primary mechanism of cholinesterase inhibition, and presumably of toxicity, for the carbamates studied.

Eldefrawi (M. E.), Miskus (R.) & Sutcher (V.). **Methylenedioxyphenyl derivatives as synergists for carbamate insecticides on susceptible, DDT-, and parathion-resistant house flies.**—*J. econ. Ent.* **53** no. 2 pp. 231–234, 4 figs., 12 refs. Menasha, Wis., 1960.

Evaluations were made of various compounds containing the 3,4-methylenedioxyphenyl group as synergists for four carbamate insecticides, Sevin, Dimetilan (3-methyl-5-pyrazolyl dimethylcarbamate), Pyrolan and Isolan. Acetone solutions of the insecticides and synergists were applied topically to females of *Musca domestica* L. from three strains, of which one had been bred in the laboratory for several generations without exposure to any insecticide and the other two were resistant to DDT and parathion, respectively. In this study, insecticide: synergist ratios of 1–50 : 1 were used. Treated flies were given sugar and water, and mortality counts were taken after 24 hours. The following is based on the authors' abstract and conclusions. Only sesamex and 3,4-methylenedioxyphenyl benzenesulphonate were found to be active synergists for the four insecticides. DDT- and parathion-resistant flies showed cross-resistance to the four test carbamates. Studies *in vitro* of the inhibition of cholinesterases from human blood plasma and fly heads showed that with the exception of Sevin, the carbamates studied are less active inhibitors of insect than of human cholinesterase.

Sullivan (W. N.) & Smith (C. N.). **Exposure of house flies and oriental rat fleas on a high-altitude balloon flight.**—*J. econ. Ent.* **53** no. 2 pp. 247–248, 1 fig., 3 refs. Menasha, Wis., 1960.

Larvae and adults of *Musca domestica* L. and pupae and adults of *Xenopsylla cheopis* (Roths.) were exposed in paper bags inside the air-conditioned gondola of a balloon during a flight in which an altitude of 78,000–82,000 ft. was maintained for 16 hours. At this height the cosmic ray intensity is 60 times that at sea-level, and ionisation-chamber readings showed the integrated dose to have ranged from 14 to 20 milliröntgens. Vials containing *X. cheopis* were also secured to the outside of the gondola. Higher mortality occurred among fly larvae exposed within the gondola than among unexposed controls, but there was little difference between the percentage mortality of the fleas exposed in the gondola and that of the controls, though all those attached to the outside of the gondola were killed by the extremely low temperatures at the high altitudes. The survivors were bred through two generations, and no genetic effects were apparent in either species, reproduction in the succeeding generations being normal and no physical abnormalities being observed.

Hoffman (R. A.). **Laboratory evaluation of several insecticides against** *Chrysops* **larvae.**—*J. econ. Ent.* **53** no. 2 pp. 262–263, 10 refs. Menasha, Wis., 1960.

Larvae of *Chrysops flavida reicherti* Fairchild recovered from water-saturated soil on the shore of a lake in Mississippi in February and March 1957 were exposed to solutions or emulsified solutions of 20 insecticides. Twenty larvae of similar size were introduced into a glass vessel containing the toxicant and kept at 23·5°C. [74·3°F.]. Mortality was recorded after 48 hours. Generally, the organophosphorus compounds caused higher mortalities than the chlorinated hydrocarbons or the thiocyanates at equivalent concentrations. Parathion was the most toxic material, causing 100 per cent. mortality at five parts per million in both an acetone-water solution and an oil emulsion; γ BHC (lindane) gave 95 per cent. mortality at 10 p.p.m. and was as effective as any of the organophosphates except parathion. The thiocyanates had little effect.

Claborn (H. V.), Ivey (M. C.) & Mann (H. D.). **A colorimetric method for the determination of Co-Ral in animal tissues.**—*J. econ. Ent.* **53** no. 2 pp. 263–265, 1 fig., 3 refs. Menasha, Wis., 1960.

The following is substantially the authors' abstract. Sprays of coumaphos (Co-Ral) have been used for the control of *Hypoderma* larvae in cattle, and a colorimetric method is described for the determination of residues of this insecticide in animal tissues and milk. The method has a sensitivity of 0·1 part per million with a sample of 50 g. and 0·2 p.p.m. with one of 25 g.

Harris (J. J.), Neel (W. W.) & Ellis (L. L.). **A study of the histological effects of** *Hypoderma lineatum* **(De Vill.) on gullet tissue taken from systemically treated and untreated cattle.**—*J. econ. Ent.* **53** no. 2 pp. 280–282, 8 refs. Menasha, Wis., 1960.

The following is mainly the authors' abstract. Coumaphos (Co-Ral) was administered to cattle from Louisiana as an oral drench at the rate of 10 mg. per kg. body weight or as a 0·5 per cent. spray for the control of *Hypoderma lineatum* (Vill.), and the gullets of treated and untreated animals were examined for any histopathological changes in the tissues. The insecticide was effective for the control of *Hypoderma* larvae as a spray but ineffective as an oral drench [*cf. R.A.E.*, B **47** 138, 168; **48** 195]. Connective tissue surrounding the larvae in the gullets of animals sprayed with coumaphos appeared to be the same as that of untreated animals, and the tissue of the oesophagus proper was normal. All sections of the connective tissue surrounding the larvae in the gullets of animals given an oral drench of coumaphos showed very heavy infiltration of lymphocytes, macrophages, neutrophiles and a slight increase in plasma cells, though tissue layers of the oesophagus proper appeared to be normal except for the submucosa. This probably indicates that the use of coumaphos as a drench not only fails to give control of *Hypoderma* larvae but is detrimental as well.

Gersdorff (W. A.), Piquett (P. G.), Gertler (S. I.) & Alexander (B. H.). **Comparative value of some synthetic compounds as synergists with barthrin in house fly sprays.**—*J. econ. Ent.* **53** no. 2 pp. 282–285, 10 refs. Menasha, Wis., 1960.

The following is substantially the authors' abstract. The effectiveness of 26 new synthetic compounds containing a methylenedioxyphenyl group as synergists for barthrin (6-chloropiperonyl chrysanthemate) was compared by the Campbell turntable method [*R.A.E.*, B **26** 246] with that of piperonyl butoxide, sulfoxide and sesamex. The materials were applied to *Musca domestica* L. as sprays in refined kerosene (Deobase) at a synergist : insecticide ratio of 10:1. The most effective were sesamex, 2-(2-(2-butoxyethoxy)-ethoxy)ethyl α-ethylpiperonyl acetal of acetaldehyde and its ethoxy analogue and piperonyl butoxide [*cf.* **49** 32], which were about equally synergistic.

Piquett (P. G.), Gersdorff (W. A.) & Alexander (B. H.). **Screening tests with synthetic compounds as synergists for house fly sprays.**—*J. econ. Ent.* **53** no. 2 pp. 299–301, 6 refs. Menasha, Wis., 1960.

The results are given of preliminary evaluations by the Campbell turntable method [*R.A.E.*, B **26** 246] of the effectiveness of 56 synthetic compounds as synergists for pyrethrins and allethrin when applied as space sprays for the control of *Musca domestica* L. Compounds were tested as solutions in refined kerosene (Deobase), and acetone was sometimes added as an auxiliary solvent. Sprays contained 0·5 mg. pyrethrins or 0·25 mg. allethrin per ml. and a tenfold concentration of the compound being tested for synergism. Sprays containing 1, 2 and 4 mg. pyrethrins and 0·5, 1 and 2 mg. allethrin per ml. solvent were used as standards of comparison. With pyrethrins, the most useful were the butyl 2-methyl-3-(3,4-methylenedioxyphenyl)propyl acetal of acetaldehyde and its isobutyl analogue, which were about as effective as piperonyl butoxide. These two and some of the others had a similar action with allethrin, but the effect was never more than moderate.

Roberts (R. H.), Jones (C. M.) & Gless (E. E.). **Methods for the evaluation of stable fly toxicants and repellents.**—*J. econ. Ent.* **53** no. 2 pp. 301–303, 6 figs., 1 ref. Menasha, Wis., 1960.

A technique was developed for the preliminary evaluation of limited quantities of insecticides, using *Stomoxys calcitrans* (L.) as the test insect. Spot tests using 250 mg. or less of the test material dissolved in acetone or another solvent were first carried out, sprays being applied to areas, about 6 in. in diameter, marked on the upper part of the bodies of cattle; the spray was confined to each area with a metal cone. Twenty-five adults of *S. calcitrans* that had not fed for 18 hours were confined in special cages on the treated area on the animal and left for 20 minutes. Toxicity was measured by the mortality of flies 24 hours after exposure, knockdown by the numbers unable to move immediately after removal from the test area, and repellency by subtracting the number that fed from the total number of flies. Materials showing promise were further evaluated in cage tests by spraying an animal with 1 U.S. gal. of the insecticide at concentrations indicated by the spot tests, placing it in a screened cage and exposing it to 100 starved flies at various intervals after treatment. After two hours, the survivors were collected and kept for 24 hours.

The order of effectiveness of acetone solutions of 0·5 per cent. DDT, methoxy-DDT (methoxychlor), malathion, toxaphene and coumaphos (Co-Ral) and 0·05 per cent. pyrethrins in spot tests against *S. calcitrans* was much the same as that shown in the usual field applications, though their actual effectiveness was greater. In a cage test, a 0·5 per cent. suspension of methoxy-DDT gave 100 per cent. mortality for four days only, and 100 per cent. knockdown was not recorded, whereas in the spot test with this compound, mortality and knockdown were complete for seven days.

The cage test is considered important in that it resembles practical application more closely.

Hansens (E. J.). **Field studies of house fly resistance to organophosphorus insecticides.**—*J. econ. Ent.* **53** no. 2 pp. 313–317, 4 figs., 3 refs. Menasha, Wis., 1960.

The following is substantially the author's abstract. Sprays of diazinon and fenchlorphos (ronnel) have been applied in dairy barns in New Jersey for more than five years for the control of *Musca domestica* L., but showed a decrease in effectiveness in 1959. Flies collected from several of these barns and exposed for 15 or 60 minutes on plywood panels bearing deposits of 1 mg. diazinon or DDT or 0·1 mg. fenchlorphos or γ BHC (lindane) per sq. in. were found to be resistant to these compounds. Flies collected in more than 20 barns at distances up to five miles away were exposed in the same way to diazinon, fenchlorphos, DDT, γ BHC and malathion, and all showed some degree of resistance to the organophosphorus insecticides and a higher resistance to the chlorinated hydrocarbons, with the highest to DDT. Resistance decreased with the distance of the barns from those first studied, in which a large population of house-flies present before application of insecticide had a lower level of resistance than a smaller number of flies present soon after an application of insecticide. Highest resistance, therefore, was related to the greatest amounts of insecticide in the barn and the highest kill of susceptible flies. In one barn, a similar reduction in fly population and an increase in resistance resulted when dung supporting heavy fly breeding was removed from stalls. In field tests, dimethoate and malathion gave unsatisfactory control in barns in which the flies were appreciably resistant to diazinon and fenchlorphos, but at other places dimethoate proved effective.

LaBrecque (G. C.) & Wilson (H. G.). **Effect of DDT resistance on the development of malathion resistance in house flies.**—*J. econ. Ent.* **53** no. 2 pp. 320–321, 1 ref. Menasha, Wis., 1960.

The selection of *Musca domestica* L. by exposure to DDT seldom gives more than slight resistance to organophosphorus insecticides [*R.A.E.*, B **49** 98], and tests were carried out to determine whether this slight resistance has any effect on the further development of resistance to organophosphates. Two colonies of flies were used in the tests; the first had been subjected to 273 generations of selection by exposure to DDT, was practically immune to this compound and showed three- to eightfold resistance to malathion, and the second was susceptible to all insecticides. In each generation of both strains, 100–200 4- to 5-day-old females were exposed in a wind tunnel to 0·25 ml. of a kerosene spray containing enough malathion to cause 90–95 per cent. mortality, so that the selection pressure was the same for both strains and throughout the observations. After exposure, flies were kept for 24 hours, mortality was recorded and the survivors were released in a cage containing oviposition medium for the breeding of further generations. The progress of the development of resistance was followed by exposing females in the wind tunnel to sprays containing a range of concentrations of malathion, and mortality was recorded as in the selection tests. The degree of resistance was determined from the ratio of the LC50's and LC90's of the two selected strains to those derived from concurrent tests with flies from the parent colonies. The strain previously selected by exposure to DDT developed resistance to malathion much more rapidly than the susceptible strain, resistance in the former being 20- to 40-fold and in the latter below threefold by the 14–17th generations.

Roberts (R. H.) & Radeleff (R. D.). **Toxaphene residues in hogs.**—*J. econ. Ent.* **53** no. 2 p. 322, 3 refs. Menasha, Wis., 1960.

Toxaphene has been used successfully for the control of *Haematopinus suis* (L.) (*adventicius* Neum.) on pigs [*cf. R.A.E.*, B **39** 171], and in 1957 an experiment was carried out in Texas to determine the amount of toxaphene present in the tissues of pigs that had been sprayed with it. Pigs that had not been exposed to chlorinated hydrocarbons were divided into three groups of six; one was sprayed with water alone, and the others with 0·5 per cent. toxaphene in emulsified solution prepared from a concentrate containing 25 per cent. toxaphene, 65 per cent. xylene and 10 per cent. Triton X-100. The third group was re-sprayed two weeks later. Three pigs from each of the treated groups were killed four weeks, and the remaining three six weeks, after treatment. Two of the pigs used as controls were killed at each slaughter. Analysis of fat samples showed that toxaphene was absent from the omental fat, but present in the renal fat four weeks, though not six weeks, after treatment; the amount was greater in the animals that received two treatments.

Ware (G. W.) & Terranova (A. C.). **The effects on house flies of adding wheat germ and corn oils to fly media.**—*J. econ. Ent.* **53** no. 2 pp. 325–326, 4 refs. Menasha, Wis., 1960.

An account is given of investigations showing that the addition of wheat-germ oil (a good source of vitamin E) or maize oil to the CSMA medium for rearing larvae of *Musca domestica* L. [*R.A.E.*, B **44** 25, etc.] was of no value.

Roberts (R. H.), Jackson (J. B.), Westlake (W. E.), Ackerman (A. J.) & Claborn (H. V.). **Residue studies of livestock sprays containing Sevin.**—*J. econ. Ent.* **53** no. 2 pp. 326–327, 6 refs. Menasha, Wis., 1960.

Sevin has shown promise for the control of various insects affecting livestock, and tests were carried out in Texas in 1958 to determine whether this insecticide is secreted in the milk or stored in the tissues of animals treated with it. Two cows and two steers were sprayed with a 0·5 per cent. suspension of Sevin four times at intervals of four days, the shortest period of protection afforded by it against *Siphona irritans* (L.). Milk taken from the cows before and at intervals varying between five hours and four days after treatment, and samples of omental fat taken from the steers one week before the first treatment, immediately before the second, and five days after the last were analysed. Sevin was not found in any of the milk samples, and there were no residues of Sevin or α-naphthol in the omental fat.

Rodriguez (J. L.) & Riehl (L. A.). **The malathion dust-bath for control of five species of lice on chickens.**—*J. econ. Ent.* **53** no. 2 p. 328, 1 ref. Menasha, Wis., 1960.

As good control of *Menacanthus stramineus* (Nitzsch) on hens has been obtained with malathion applied to natural dusting wallows in the soil of fowl pens and in dust-bath boxes [*R.A.E.*, B **46** 45], the effectiveness of this method for the control of other lice on hens was investigated on six poultry farms in southern California. At three establishments, dust-bath boxes, at the rate of 1 per 100 birds, were placed over favourite wallows in the litter of the pens, and 4 per cent. malathion dust, at the rate of 1 lb. per 100 hens, was added. At two of these farms, there were 300–400 hens per pen, infested with mixed populations of *M. stramineus*, *Goniocotes gallinae* (Deg.) and *Menopon gallinae* (L.), and at the third 500 per pen, infested with *G. gallinae*. At the other three farms, malathion was applied, at the same rate and concentration, to wallows in the soil of the pens; at these farms there were 25, 100 and 30 birds per pen, and the lice concerned were *M. gallinae*, *Lipeurus caponis* (L.) and *Cuclotogaster heterographa* (Nitzsch), respectively. Hens were examined for lice before and at intervals of seven days after treatment. In those farms where malathion was applied in the dust-bath boxes, hens were free of lice within 7–14 days after the boxes were put in the pens and remained free from infestation for 84–108 days. At the other three farms, birds were free seven days after malathion was applied in the natural wallows and remained free for 84–100 days.

Rodriguez (J. L.) & Riehl (L. A.). **Malathion dust for chicken mite control.** —*J. econ. Ent.* **53** no. 2 pp. 328–329, 4 refs. Menasha, Wis., 1960.

The effectiveness of malathion dust against *Dermanyssus gallinae* (Deg.) on hens in henhouses or cages with wooden parts [*cf. R.A.E.*, B **47** 102] was tested on four poultry farms in southern California. At two of the farms, hens were kept in henhouses at the rate of 300–600 per house, at the third in cages at 50–70 per cage, and at the fourth in both, at 16 hens per cage or 250–300 per henhouse. After removal of eggs and feed, 4 per cent. malathion dust was applied to all wooden surfaces or roosts, joists, troughs and nest boxes at the rate of 2 lb. per 36 linear ft. Before treatment, all the houses and cages were heavily infested with all stages of *D. gallinae*, but no mites were found seven days after the dusting with malathion or thereafter for at least 150 days at the first three farms and for 90 days at the fourth. Units left untreated for 90 days remained heavily infested.

Smith (W. W.). **Rat, flea, and murine typhus recurrence following eradication measures.**—*Publ. Hlth Rep.* **73** no. 5 pp. 469–473, 4 refs. Washington, D.C., 1958.

Two years after the end of a campaign for the control of rats (*Rattus rattus* and *R. norvegicus*) and *Xenopsylla cheopis* (Roths.) in a rural area of Georgia [*R.A.E.*, B **47** 156], carried out for the elimination of murine typhus, four rats of a total of 142 trapped had typhus antibodies, but no antibodies were found in 148 taken at the end of the third year, although some of the rats were infested with *X. cheopis* in both years. No human cases of murine typhus were known to have occurred in the experimental area since May 1954, when control operations ended.

Macdonald (W. W.). **A resurvey of *Aedes aegypti* at Kuala Lumpur Airport.**—*Med. J. Malaya* **13** no. 2 pp. 179–186, 2 figs., 6 refs. Singapore, 1958.

The following is substantially the author's abstract. Measures to eradicate *Aëdes aegypti* (L.) from a zone 400 yd. wide round the perimeter of the Kuala Lumpur airport were carried out in 1955–57, and a resurvey between January and June 1958 showed that eradication had virtually been accomplished but that there were still heavy concentrations of the mosquito in the urban area to the north of the control zone, the extension of which northwards is therefore recommended. The measures used were six-monthly perifocal spraying [*R.A.E*, B **46** 193] with 5 per cent. DDT and destruction of potential breeding places at irregular intervals. However, as DDT has not been generally satisfactory against *A. aegypti* in Malaya [*loc. cit.*] and G. B. Craig found that strains from Kuala Lumpur with no history of previous exposure were more resistant than strains from other parts of the world [*cf.* **43** 169; **49** 94], dieldrin was substituted at the airport in August 1957 and proved more effective. Present measures are perifocal spraying with 1 per cent. dieldrin, which must now be considered the insecticide of choice for the control of *A. aegypti* in Malaya, in sectors still showing this mosquito, combined with regular inspection of premises and destruction of potential breeding places in all sectors.

CORBET (P. S.). **Recognition of individual nulliparous and parous mosquitoes.**—*Trans. R. Soc. trop. Med. Hyg.* **53** no. 3 p. 297, 3 refs. London, 1959.

Colless's method for distinguishing parous from nulliparous mosquitos [*R.A.E.*, B **48** 215] was successfully used by the author for East African Culicines of several genera and also for *Haematopota* and *Tabanus*. However, certain species were graded much more rapidly by a combination of this method with one described by T. S. Detinova. The latter uses the irreversible straightening of the ovarian tracheoles that occurs during the first gonotrophic cycle [**34** 180]. Its main limitation [the fact that it cannot be applied with certainty to ovaries at a later stage than stage II of Christophers (**29** 93)] is immaterial with mosquitos caught while they are coming to bite, since hardly any will have ovaries that have developed beyond this stage. Large numbers of such mosquitos can therefore be dealt with expeditiously by examination of the tracheoles and subsequent search for corpora lutea in the few individuals that remain doubtful. Working in this way with *Mansonia fuscopennata* (Theo.), the author easily dealt with 70–80 females per hour.

PAPERS NOTICED BY TITLE ONLY.

MOLEV (E. V.). **The rearing of Ceratopogonids of the genus *Culicoides* in laboratory conditions.** [*In Russian.*]—*Zool. Zh.* **37** pt. 10 pp. 1563–1568, 5 figs., 22 refs. Moscow, 1958. (With a summary in English.)

SULLIVAN (R. L.) & HIROYOSHI (T.). **A preliminary report on mutations in the house fly** [*Musca domestica* L.].—*J. econ. Ent.* **53** no. 2 pp. 213–215, 1 fig., 6 refs. Menasha, Wis., 1960.

CUSHMAN (H. G.). **Index XVII to the literature of American economic entomology January 1, 1958–December 31, 1958.**—*Spec. Publ. ent. Soc. Amer.* no. 17, x+501 pp. College Park, Md., 1960. [*Cf. R.A.E.*, B **48** 84.]

NUORTEVA (P.). **Studies on the significance of flies in the transmission of poliomyelitis. I. The occurrence of the *Lucilia* species (Dipt., Calliphoridae) in relation to the occurrence of poliomyelitis in Finland.**—*Ann. ent. fenn.* **25** no. 1 pp. 1–24, 13 figs., 38 refs. Helsinki, 1959. **II. The composition of the annual blowfly population as compared with the incidence of poliomyelitis in England during the years 1949–1952.**—*T. c.* pp. 25–27, 1 graph, 4 refs. **III. The composition of the blowfly fauna and the activity of the flies in relation to the weather during the epidemic season of poliomyelitis in south Finland.**—*T. c.* no. 3 pp. 121–136, 6 figs., 22 refs. **IV. The composition of the blowfly fauna in different parts of Finland during the year 1958.**—*T. c.* pp. 137–162, 13 figs., 27 refs.

The first of these papers opens with a review of the literature as to the transmission of poliomyelitis viruses by flies and a discussion of the implications. The only evidence that poliomyelitis viruses occur in vertebrate hosts other than man and monkeys is the finding of antibodies against the mouse-adapted Lansing strain in certain animals. The author nevertheless concludes from consideration of the species of flies from which virus has been isolated [*R.A.E.*, B **43** 88, 115], mostly blowflies that develop in carrion, that the flies are more likely to have acquired the virus from dead animals than from human faeces. In support of this view, he points out that infection is commonly found in flies when an epidemic is at its height but not when it is beginning to decline [*cf.* **40** 69; **43** 88], though faecal material containing virus is more plentiful at the end of an epidemic. The possibility that Coxsackie and similar viruses [**41** 86] that are nearly related to those causing poliomyelitis and occur in small rodents [**42** 121] may become transformed into true poliomyelitis viruses is also suggested. The flies are strongly attracted to wounds and would probably introduce the virus into man through them, possibly increasing the incidence of paralytic cases, which are particularly associated with trauma, as well as general infection. Paralytic poliomyelitis in Europe and the United States is associated not with standards of hygiene but with species of flies, the more northerly areas where its incidence is greatest being those where blowflies predominate over *Musca domestica* L.

To investigate the hypothesis of transmission by flies, the occurrence and bionomics of different species and their ability to transmit viruses were studied in Finland. Poliomyelitis occurs throughout the country but is less frequent in the north, and the same applies to flies of the genus *Lucilia*. *L. fuscipalpis* (Zett.) occurs only north of 68°N. lat., but *L. illustris* (Mg.), *L. silvarum* (Mg.), *L. caesar* (L.), *L. richardsi* Collin and *L. sericata* (Mg.) occur only south of about 68°, 65°, 64°, 62°30′ and 61° N. lat., respectively. *L. sericata* is more urban than the other species, but the higher mean morbidity from poliomyelitis in large cities could not be correlated with its occurrence. The flying season of each species is more confined to the middle of the summer in the north than in the south, and this is true also to some extent of the seasonal incidence of poliomyelitis. An increase in the abundance of *L. sericata*, a very late-flying species, precedes the summer increase in the incidence of poliomyelitis in Helsinki by 1–2 weeks, a time roughly equal to the incubation period of the disease in man. Poliomyelitis occurs significantly earlier outside the southern coastal area, where *L. sericata* is replaced by earlier-flying species of *Lucilia*. The maximum seasonal abundance of these species occurs about 1½ months before that of poliomyelitis, but *L. illustris* and *L. caesar* may be involved in transmission as they do not oviposit until 1½–2 months after the beginning of their flight season.

The following paragraphs are based on the author's summaries of the other three papers, respectively.

Some results of Macleod & Donnelly's four-year survey of the blowfly fauna of an area of northern England [**47** 90] are compared with statistics of the incidence of poliomyelitis. *L. caesar* and *L. illustris* are shown to have been exceptionally abundant in 1950, the year in which a major poliomyelitis epidemic occurred in the British Isles. As increased abundance of *L. illustris* has also been observed to coincide with epidemic years in the United States, it seems possible that this species is implicated in the spread of the disease. Both in the United States and in England, *Calliphora vicina* R.-D. (*erythrocephala* (Mg.)) has been found to be scarce in an epidemic year but plentiful in the preceding year.

The species of blowflies present and their activity during the poliomyelitis epidemic season were studied by means of baited traps in southern Finland, and a statistical comparison made of the annual incidence of poliomyelitis and the occurrence of weather conditions suitable for blowfly activity. The most abundant blowfly species were *L. illustris*, *L. caesar*, *C. vicina* and *C. vomitoria* (L.). Replacement of *Lucilia* as the dominant genus by *Calliphora* occurred during the peak and subsequent decline of poliomyelitis epidemics. The blowflies were active during sunshine and on cloudy days when the general temperature was 16°C. [60·8°F.] or more. Numbers of cloudy days, which are unfavourable for blowfly activity, showed a positive correlation with the incidence of poliomyelitis. Although this fact may be an indication that the hypothesis of transmission by flies is invalid, it may be that the inhibition of normal ovipositional activity drives more of the flies to the surface of warm-blooded animals or to dwellings.

The blowfly fauna of different parts of Finland was studied by trapping in 1958, and 11 species were taken. *Phormia terraenovae* R.-D. was the dominant species in the north and *L. illustris* and other species of *Lucilia* in the south. The reasons for this are discussed, and it is concluded that the ability of *P. terraenovae* to tolerate unfavourable conditions, its rapidity of development and its comparative inability to compete with other species are responsible. The seasonal abundance of ovipositing females of *L. illustris* and *L. caesar* resembled the seasonal incidence of poliomyelitis more than did the abundance of these species as a whole. Comparison of the seasonal incidence of the flies with that of poliomyelitis showed that the most likely vectors were *L. illustris*, *C. vicina* and *C. uralensis* Villen. in the north, *L. illustris* and *L. caesar* in the centre and *L. sericata*, *L. richardsi*, *L. illustris* and *L. caesar* in the south. In general, *P. terraenovae* and *Cynomyia mortuorum* (L.) are dominant in the spring, *Lucilia* spp. in the summer and *Calliphora* spp. in the autumn. In northern Finland, the phase of *Lucilia* dominance is absent. A second generation of *P. terraenovae* appears in June in the southernmost part of Finland, but towards the north it is gradually postponed and does not occur at all in the extreme north; a possible connection between the habits of this blowfly and the disease is discussed.

Sen (P.). **Insecticide resistance in the mosquito** *Culex fatigans* **Wied. of Calcutta.**—*Bull. Calcutta Sch. trop. Med.* **7** no. 3 pp. 109–110, 6 refs. Calcutta, 1959.

In tests by the technique of Busvine & Nash [*R.A.E.*, B **41** 156], with exposure for one hour, the LD50 of DDT for adults of *Culex pipiens fatigans* Wied. from the outskirts of Calcutta was found to be about 2 per cent., but exposure for four hours to 3 per cent. or for three hours to 4 per cent. was needed to give the same degree of control of a laboratory-bred strain from the city itself. The reason for the strong resistance in the latter strain is not known. Anti-larval oiling has been practised in the city for 20 years, but DDT and γ BHC (gammexane) in suspension or solution have been used occasionally to treat breeding places. Tests with BHC and dieldrin also gave some indication that the laboratory strain was resistant to these insecticides, but it was highly susceptible to malathion and diazinon. Subjection to DDT pressure for three generations failed to increase its resistance to this insecticide any further.

BERAN (F.). **Die DDT-Empfindlichkeit verschiedener österreichischer Herkünfte von** *Musca domestica* **L.** [The susceptibility to DDT of different Austrian strains of *M. domestica*.]—*Bodenkultur* **11** pt. 2 pp. 131–140, 27 refs. Vienna, 1960. (With a summary in English.)

The following is based on the author's summary. The susceptibility to DDT of strains of *Musca domestica* L. from different parts of Austria was compared by the topical method, and in some cases by the deposit method also, with that of two normally susceptible laboratory strains. Several of the strains gave evidence of slight resistance, and the resistance of one was about 25 and 12 times that of the two laboratory strains. It is concluded that statements on insecticide resistance cannot be generalised without thorough investigation. The failure to detect any highly resistant strains in Austria 15 years after the introduction of DDT is considered surprising. In spite of it, rotation of insecticides is recommended.

WALTON (G. A.). **A biological variant of** *Ornithodoros moubata* **Murray (Ixodoidea: Argasidae) from South Africa.**—*Proc. R. ent. Soc. Lond.* (A) **34** pt. 4–6 pp. 63–72, 3 figs., 8 refs. London, 1959.

The following is based on the author's summary. Evidence is given for the existence of a distinct southern African domestic form of *Ornithodoros moubata* (Murr.) designated form E, comprising strains derived from six widely separated localities in Angola, Bechuanaland, western Transvaal and South-West Africa and differing from the East African forms, A, B, C and D [*R.A.E.*, B **48** 144, etc.], in being light grey in colour and smaller and having paler, more slender legs and a shorter life-cycle. It also differs in appearance and behaviour during feeding from all except the wild form, C, which occurs in the burrows of wart-hogs [*Phacochoerus aethiopicus*]. The coxal fluid appears later during a feed than in the East African domestic forms but earlier than in form C [*cf.* **48** 145]. Most males of form E reached maturity after three nymphal feeds and none needed five; most females reached maturity after four feeds and some after three, and generally less than 1 per cent. required five, whereas no females of the East African strains are known to have reached maturity with less than four feeds. This characteristic behaviour of the southern African strains was shown to be hereditary. Whereas emergence from the egg is delayed in the East African forms until the larval moult has occurred, a semi-active larva hatches in form E and then becomes inactive until it moults.

Form E is adapted to withstand severe desiccation, occurring in the Kalahari Desert, and the isotherm for 70°F. appears to be the limit of its southern distribution. Thus, it inhabits cool and dry country, as distinct from the hot and dry country inhabited by form D, the cool and wet country inhabited by form A and the hot and moist conditions favoured by form B. It has only rarely been found to be infected by *Borrelia* (*Spirochaeta*) *duttoni*, and may therefore be an inefficient vector of human relapsing fever.

Ogita (Z.). **The genetical relation between resistance to insecticides in general and that to phenylthiourea (PTU) and phenylurea (PU) in** *Drosophila melanogaster.—Botyu-Kagaku* **23** pt. 4 pp. 188–205, 15 refs. Kyoto, 1958. (With a summary in Japanese.)

The following is based on the author's summary and discussion. The levels of resistance to phenylthiourea (PTU) and phenylurea (PU) were determined for strains of *Drosophila melanogaster* Mg., of which some were resistant and others susceptible to DDT, BHC and parathion. Strains resistant (or susceptible) to PU were also resistant (or susceptible) to DDT. All the strains that were resistant to PTU were susceptible to DDT, but those susceptible to PTU were of two types, one DDT-resistant and the other DDT-susceptible. Genetical analysis indicated that a dominant gene that confers resistance to DDT, BHC and parathion also confers resistance to PU and abnormal susceptibility to PTU, and a logical outcome of this is to consider that PTU pressure could restore DDT-susceptibility to a strain that has become resistant. It is suggested that a mixture of DDT, BHC or parathion with a substance correlated negatively with them, such as PTU, might prove to be an effective insecticide that would not produce strains resistant to it even after continuous use.

Ikeda (Y.). **Behavior of housefly to certain organic phosphorus insecticides.** *—Botyu-Kagaku* **24** no. 1 pp. 22–25, 5 refs. Kyoto, 1959. (With a summary in Japanese.)

In tests in Japan, filter papers were impregnated with solutions of phosphorus insecticides and then, after these had almost dried, were moistened with sugar solution and exposed to adults of *Musca domestica vicina* Macq. in cages. The results showed that diazinon, trichlorphon (Dipterex), malathion and fenchlorphos (Korlan) repelled the flies at high concentrations, though not at low ones. Dichlorvos (DDVP) had no repellent effect at any concentration.

Buéi (K.). **Seasonal prevalence of flies in Osaka.** [*In Japanese.*]*—Botyu-Kagaku* **24** no. 1 pp. 47–54, 3 figs., 18 refs. Kyoto, 1959. (With a summary in English.)

The results are given of investigations in which flies were trapped by means of a fish bait in a town in Osaka Prefecture between May 1953 and December 1955, together with details of the seasonal succession of the more important of the 24 species taken. Of these, *Lucilia cuprina* (Wied.), *L. sericata* (Mg.), *L. illustris* (Mg.) and *Calliphora grahami* Aldr. constituted 44·7, 20·1, 13·6 and 14·8 per cent., respectively.

Buéi (K.). **The effect of temperature on fecundity of the common housefly,** *Musca domestica vicina* **Macquart.** [*In Japanese.*]*—Botyu-Kagaku* **24** no. 2 pp. 78–83, 2 graphs, 15 refs. Kyoto, 1959. (With a summary in English.)

In tests in which single pairs of *Musca domestica vicina* Macq. were kept at temperatures of 15–37°C. [59–98·6°F.] and supplied with suitable food, pairing occurred at all temperatures, and eggs were laid at all but 15°C.

The numbers of egg-batches per female were 1·8 at 25°C. [77°F.] and 3·7 at 37°C. and highest (5·2) at 29°C. [84·2°F.], at which temperature the interval between batches was shortest. There was no difference in the size of the batches. Reproduction declined with the age of the female, that of the male having little effect within the limits of the observation period (25 days).

Boorman (J. P. T.). **Observations on the feeding habits of the mosquito** *Aëdes* (*Stegomyia*) *aegypti* (**Linnaeus**)**: the loss of fluid after a blood-meal and the amount of blood taken during feeding.**—*Ann. trop. Med. Parasit.* **54** no. 1 pp. 8–14, 13 refs. Liverpool, 1960.

During experiments in which females of *Aëdes aegypti* (L.) were allowed to ingest virus-bearing blood through a mouse-skin membrane [*R.A.E.*, B **46** 97], it was noted that fully engorged individuals usually excreted drops of fluid through the anus immediately after withdrawal of the proboscis and some did so while still feeding. The following is based mainly on the author's summary of a study of the fluid, of which the amount passed after one meal was estimated to be about 1·5 cu. mm. Analysis of the composition of the fluid and experiments with blood marked with radioactive cerium (^{144}Ce) or sulphur (^{35}S) and with blood containing dye indicated that the fluid is derived mainly from the blood-meal, by absorption through the wall of the mid-gut, resorption from the haemolymph by the Malpighian tubes and excretion into the hind-gut. Whole blood was occasionally passed, and in this case, when the blood-meal contained living Semliki Forest virus, virus was also present in the fluid, but it was absent when blood was not passed. It is concluded that excretion after feeding is unlikely to be of importance as a means of mechanical transmission of viruses. Estimates of blood-meal size obtained by marking the blood with ^{144}Ce were 68 per cent. higher than the commonly accepted estimate of 2·5 cu. mm., obtained by weighing insects before and after feeding without allowance for loss of fluid in the excreta. Such marking provides a method of estimation independent of such loss of fluid because the cerium is not eliminated in the excreta immediately after feeding. It is suggested that the normal size of a blood-meal for *A. aegypti* is of the order of 4–4·5 cu. mm. Marking with ^{35}S as sodium sulphate gave lower figures than marking with cerium because some of the isotope is lost in the excreted fluid, and some of the radiation disappears by absorption in the tissues.

Ashcroft (M. T.). **A comparison between a syringe-passaged and a tsetse-fly-transmitted line of a strain of** *Trypanosoma rhodesiense*.—*Ann. trop. Med. Parasit.* **54** no. 1 pp. 44–53, 2 graphs, 16 refs. Liverpool, 1960.

The following is substantially the author's summary. A comparison is made between some of the properties of a line of a strain of *Trypanosoma rhodesiense* that had been maintained for 20 years by syringe passage through rats and mice [*R.A.E.*, B **38** 47; **46** 95] and those of a line of the same strain that had been cyclically transmitted through sheep by *Glossina morsitans* Westw. for a similar period [**49** 51, etc.]. The syringe-passaged line was consistently monomorphic in all animals, whereas the fly-transmitted line was polymorphic. The syringe-passaged line did not infect man; it was less virulent than the fly-transmitted line to monkeys, rabbits, guineapigs and a sheep, and more virulent to rats. Monkeys and a rabbit that had recovered from an infection with the syringe-passaged line could be reinfected with the fly-transmitted, but not with the syringe-passaged, line. It is suggested that the syringe-passaged line is less capable of antigenic variation than the fly-transmitted line. Dissection of adults of *G. morsitans* that had fed on rats heavily infected with the syringe-passaged line showed that the trypanosomes of this line, in contrast to those of the other, could not develop in the fly, although some could persist in the gut for seven days. It is pointed out that the differences between the two lines may have arisen because of differences either in the method of passage or in the host animals. The two lines show such great differences that they could be regarded as belonging to separate species.

Edeson (J. F. B.). **Studies on filariasis in Malaya: the periodicity of the microfilariae of *Brugia malayi* and *B. pahangi* in animals.**—*Ann. trop. Med. Parasit.* **53** no. 4 pp. 381–387, 4 graphs, 6 refs. Liverpool, 1959.

Buckley (J. J. C.). **On *Brugia* gen. nov. for *Wuchereria* spp. of the "*malayi*" group, i.e., *W. malayi* (Brug, 1927), *W. pahangi* Buckley and Edeson, 1956, and *W. patei* Buckley, Nelson and Heisch, 1958.**—*Op. cit.* **54** no. 1 pp. 75–77, 1 fig., 6 refs. 1960.

Laing (A. B. G.), Edeson (J. F. B.) & Wharton (R. H.). **Studies on filariasis in Malaya: the vertebrate hosts of *Brugia malayi* and *B. pahangi*.**—*T. c.* pp. 92–99, 2 pls., 18 refs.

In the second paper, descriptions are given of both sexes of *Brugia*, gen. n., erected for species of *Wuchereria* of the group of *W. malayi*. The species included in the new genus, all of which are smaller than *W. bancrofti* and are parasitic in the lymphatic system of mammals, are *B. malayi*, which is known from man, cat and monkeys, is transmitted by species of *Anopheles* and the subgenus *Mansonioides* of *Mansonia* and occurs in Indonesia, Malaya, India, Ceylon and China, *B.* (*W.*) *pahangi*, a parasite of cats, dogs and various wild animals in Malaya, transmitted by species of *Mansonioides* and *Armigeres*, and *B.* (*W.*) *patei*, recently described from dog, cat and genet-cat [*Genetta*] in Kenya and transmitted by species of *Mansonioides* and *Aëdes*. The microfilariae of the three species occur in the circulatory system. They are difficult to differentiate but are morphologically distinct from those of *W. bancrofti*.

A study of the periodicity of the microfilariae of *B. malayi* and *B. pahangi* in naturally and experimentally infected animals is described in the first paper. The naturally infected animals were obtained from an area of East Pahang where filariasis due to a semi-periodic form of *B. malayi* [*cf. R.A.E.*, B **47** 4] is endemic in man. Natural infections of *B. malayi* in cats were also semi-periodic; experimental infections in cats showed the same periodicity as that originally shown in the donor. Natural infections in two long-tailed macaque monkeys (*Macaca irus*) showed nocturnal periodicity, although the developmental pattern of the microfilariae in *Mansonioides* was similar to that of the semi-periodic form from man. In a slow loris (*Nycticebus coucang*) infected with the semi-periodic form of *B. malayi* from man, the microfilariae showed an almost nocturnal periodicity. Microfilariae of *B. pahangi* were semi-periodic in all animals tested, which comprised one experimentally and two naturally infected cats, one naturally and one experimentally infected slow loris and a naturally infected dog.

The results obtained up to 30th May 1959 in blood surveys of wild and domestic animals in East Pahang, made to define the animal reservoirs of *B. malayi* and *B. pahangi*, are given in the third paper. The periodic form of *B. malayi* occurs in areas of open rice-field, such as those in north-western Malaya, and is transmitted by *Anopheles barbirostris* Wulp, members of the group of *A. hyrcanus* (Pall.), and *Mansonia indiana* Edw., *M. uniformis* (Theo.), and *M. annulifera* (Theo.). The semi-periodic form is transmitted only by species of *Mansonia* and is endemic in the villages bordering big Malayan rivers backed by swamp forest. Semi-periodic *B. malayi* and *B. pahangi* share common vectors. The animals included in the survey came from an area north of the lower reaches of the Pahang river where semi-periodic *B. malayi* was endemic. *B. malayi* was found occurring naturally in the dusky leaf-monkey (*Presbytis obscurus*), the domestic cat, the common palm-civet (*Paradoxurus hermaphroditus*), the long-tailed macaque monkey, the wild cat (*Felis bengalensis*) and the pangolin (*Manis javanica*). The high infection rate in *Presbytis obscurus* (19 out of 25) suggests that this is an important reservoir of the semi-periodic form, but infections in domestic cats are probably incidental to those in man. Two dogs have recently been infected experimentally with the semi-periodic form of *B. malayi*. *B. pahangi* was found occurring naturally in domestic cats and dogs, the slow loris, three kinds of civet (*Paradoxurus hermaphroditus*, *Arctogalidia trivirgata* and *Viverra zibetha*), wild cats (*Felis planiceps* and *F. bengalensis*), tiger, pangolin, moon-rats (*Echinosorex gymnurus*) and a giant squirrel (*Ratufa bicolor*). Man has been infected experimentally. The two species were sometimes found together in the same animals. Available evidence suggests that periodic *B. malayi* is rare in vertebrate hosts other than man, in whom it is considered to be the dominant, if not the only, form. The influence of these animal reservoirs on filariasis in man is discussed.

WHARTON (R. H.). **Studies on filariasis in Malaya: field and laboratory investigations of the vectors of a rural strain of** *Wuchereria bancrofti*.—*Ann. trop. Med. Parasit.* **54** no. 1 pp. 78–91, 26 refs. Liverpool, 1960.

It was formerly believed that filariasis due to *Wuchereria bancrofti* in Malaya was confined to immigrants and was not endemic [*cf. R.A.E.*, B **27** 11]. Although it was suspected that some transmission was taking place in Singapore, this has only recently been confirmed, and *Culex pipiens fatigans* Wied. shown to be the vector [**49** 98], as it probably is in another urban focus at Penang; no evidence of rural endemicity was known until a focus of the periodic form was found in 1956 among indigenous Malays living in an entirely rural area 40–50 miles from the mouth of the Pahang river. In such places, *C. p. fatigans* is usually present but uncommon, and attempts were therefore made to determine the vector. *Brugia malayi* [see preceding abstract] also occurs in the area, but infection rates with both parasites are low and there is virtually no filarial disease.

Collection of mosquitos in net-traps with human bait, by means of knock-down sprays in houses and on human bait outside yielded many species representing ten genera, but dissection revealed the presence of developing larvae of *W. bancrofti* only in two females of a species of *Anopheles* and of mature larvae in one female of the same species. This mosquito was at first thought to be *A. letifer* Sandosham, and is referred to as *A. letifer* in the text, but is stated in the last paragraph to be considered by J. A. Reid to represent an undescribed species in the group of *A. umbrosus* (Theo.) barely separable from *A. letifer* in the adult stage but possessing distinctive pupal characters. One sporozoite and two oocyst infections were also found in this species, and its transmission rate for *W. bancrofti* and for malaria, based on bare-leg catches, was 1·3 infective bites per year. Larvae of *B. malayi* were found in three species of the subgenus *Mansonioides* of *Mansonia*, and *Dirofilaria* and other filarial larvae were recorded in various species of mosquitos, including the species of *Anopheles* near *letifer*. This mosquito was present at all times of the year, but was abundant only for two months (April–May 1959). In two all-night catches during that period, it was taken mainly outside and during the first two hours after sunset, though biting continued to some extent throughout the night, and females of different ages were caught at all times. Other observations suggest that it needs only one blood-meal for maturation of the first batch of eggs. Breeding places varied from deeply shaded water in swamp forest, with a pH of 5·8, to open grass-swamp and clear seepage pools with pH 6·6.

Observations on the development of rural strains of *W. bancrofti* in mosquitos showed this *Anopheles* to be a good host; developing larvae were found in nine out of 16 females dissected 11–15 days after feeding on a carrier, infective larvae were found in six, and its mean index of experimental infection [**47** 5], modified to represent the number of infective larvae per mosquito when the microfilaria count is 1 per cu. mm., was 2·5. *A. barbirostris* Wulp failed to support development. Many females of species of *Mansonioides* contained larvae when dissected 10–16 days after an infective feed, but the larvae had virtually never developed beyond stage I. Larvae survived to maturity in *C. p. fatigans* and other species of *Culex*, but these were nevertheless comparatively poor hosts. The intake of microfilariae of *W. bancrofti* by *C. p. fatigans* was equivalent to the number in 12 cu. mm. blood, although the blood-meal was only 4 cu. mm., suggesting that the mosquito concentrates the microfilariae, but more evidence is required, since Omori has found, in more comprehensive investigations with *C. p. pallens* Coq., that the number of mosquitos that took in more or fewer microfilariae than expected was practically the same, although the total number of microfilariae ingested was 1½ times that expected. The mean modified index of experimental infection of *C. p. fatigans* was 2·8 for urban (Singapore) strains of *W. bancrofti* and 0·14 for rural strains; thus the species near *A. letifer* was as good a host for rural strains as was *C. p. fatigans* for urban ones. Observations on quantitative aspects of the development of urban *W. bancrofti* in *C. p. fatigans* showed that many larvae were lost during development, and infective larvae left mosquitos even though no blood-meal was taken; the presence of large numbers of larvae had no apparent effect on the survival of the mosquitos.

The spread of *W. bancrofti* through Asia and the Pacific is briefly discussed in relation to its mosquito hosts. The low numbers of *C. p. fatigans* are presumed to have been the limiting factor in the establishment of the parasite. It has become adapted to many and diverse intermediate hosts, and in some cases, long association with these hosts has caused a strain to lose affinity for *C. p. fatigans*.

Thurber (H. E.) & Peterson jr. (G. D.). **Feed lot tests with ronnel for control of cattle grubs.**—*J. econ. Ent.* **53** no. 3 pp. 339–341, 2 figs., 8 refs. Menasha, Wis., 1960.

The following is based on the authors' abstract and conclusions. Fenchlorphos (ronnel) administered in bolus form to cattle in California in 1957 at the rate of 100 mg. per kg. body weight gave the best control of larvae of *Hypoderma lineatum* (Vill.) and *H. bovis* (Deg.) when the animals were treated before the larvae reached the backs, but control was effective even when application was delayed long after the larvae had encysted. Damage to hides and carcasses was much less in the treated than in the untreated animals.

Mulla (M. S.), Barnes (M. M.) & Garber (M. J.). **Soil treatments with insecticides for control of the eye gnats** *Hippelates collusor* **and** *H. hermsi*.—*J. econ. Ent.* **53** no. 3 pp. 362–365, 6 refs. Menasha, Wis., 1960.

The following is based mainly on the authors' abstract. *Hippelates collusor* (Tns.) and *H. hermsi* Sabrosky breed predominantly in loose, cultivated soils, and investigations were carried out in California in 1956–57 on the effectiveness against them of several chlorinated insecticides when applied to the surface of the soil either as dilute sprays or on granules [*cf.* *R.A.E.*, B **47** 134]. The soil in the test plots was disked after the applications, to minimise the loss of insecticides from the surface [*cf.* **48** 95], and, 10–20 days after treatment, cages were placed on the soil to trap emerging adults. A spray of aldrin and granular formulations of aldrin and heptachlor at 3·6, 3·8 and 4·4 lb. toxicant per acre, respectively, gave moderate initial control of *H. collusor* but caused no significant reduction in breeding after 7–10 months. The short-lived effectiveness of aldrin and heptachlor in the soil is probably due to an appreciable conversion of these materials to their epoxides [*cf.* A **47** 56, etc.]. Neither aldrin nor heptachlor gave any control of *H. hermsi*. Dieldrin was not tested for its initial effectiveness, but a granular formulation at 6·4 lb. toxicant per acre gave no control of *H. collusor* seven months after application. Thiodan sprays at 6·2 lb. per acre, the highest dosage used, were ineffective against both species, and the results obtained with toxaphene were inconclusive. DDT gave a high degree of initial control of *H. collusor*, causing 95 per cent. reduction of emerging adults when applied at 13 lb. per acre, but its long-term effectiveness is not known.

Mulla (M. S.). **Chlorinated hydrocarbon insecticides as soil treatments against the eye gnat** *Hippelates collusor* **(Townsend) in the laboratory.**—*J. econ. Ent.* **53** no. 3 pp. 367–372, 1 graph, 4 refs. Menasha, Wis., 1960.

A method was developed for the preliminary evaluation in the laboratory of insecticides for use as soil treatments against *Hippelates collusor* (Tns.). In each test, 0·5–2 U.S. gal. dried sifted sand was used. Measurement of the sand by volume permitted calculation of the dosage per acre of surface to a depth of 6 in. (6-in. acre). Emulsified solutions of the insecticides were applied to the sand, or granulated formulations were spread over the surface. The treated sand, mixed in portions of 1 U.S. gal. with 60 g. lucerne meal, 30 g. brewers' yeast and 30 g. sifted wholewheat flour, was placed in jars, to each of which 170 ml. water and, 1–3 days later, 200 eggs of *H. collusor* from a laboratory colony [*cf.* *R.A.E.*, B **47** 13] were added. The jars were then covered with strainer cloth, and emerging adults were counted and removed at intervals. The following is based mainly on the author's summary of the results.

Sprays of Shell Compound SD-4402 (1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan), DDT and endrin, applied at 2·5, 18 and 5 lb. per 6-in. acre, respectively, gave percentage reductions of emerging adults of 98, 80 and 95. Aldrin, dieldrin, heptachlor, γ BHC (lindane), Kepone [2,3,3a,4,5,6,7,7a,8,8-decachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene-1-one], toxaphene and chlordane gave poor results when applied as sprays at dosages of 4–20 lb. per 6-in. acre. Granulated formulations of DDT were found to be less effective than sprays. After storage in the sand mixture for three months, the effectiveness of granules containing 20 and 35 per cent.

DDT increased somewhat but did not equal that of DDT sprays, and that of granules containing 10 per cent. nearly doubled, becoming equal to that of the sprays. The toxicity of aldrin and dieldrin sprays decreased after three months in the sand mixture [*cf.* preceding abstract], but that of DDT and endrin remained the same.

GINGRICH (R. E.). **Development of a synthetic medium for aseptic rearing of larvae of** *Stomoxys calcitrans* **(L.)**.—*J. econ. Ent.* **53** no. 3 pp. 408–411, 8 refs. Menasha, Wis., 1960.

The following is based mainly on the author's abstract. Larvae of *Stomoxys calcitrans* (L.) were reared successfully on a sterile synthetic medium containing an amino acid mixture as the source of protein and an aqueous extract from bakers' yeast. The survival of larvae reared on this medium was nearly as high as that of larvae reared on one that was not aseptic, but development took longer. No attempt was made to determine which of the constituents of the medium were essential, or their optimum concentrations.

STOCKDALE (H. J.) & RAUN (E. S.). **Economic importance of the chicken body louse.**—*J. econ. Ent.* **53** no. 3 pp. 421–423, 2 graphs, 3 refs. Menasha, Wis., 1960.

Experiments were carried out in Iowa in 1958–59 on the effect of infestation by *Menacanthus stramineus* (Nitzsch) on the egg-production [*cf. R.A.E.*, B **48** 127] and gain in weight of fowls, and the following is based on the authors' summary of the results. Adults of *M. stramineus* were placed, at the rate of three per bird, on four pullets and a rooster in each of 11 pens, and fowls in 11 similar pens were kept free of lice. It was considered that one egg produced by one hen each day constituted 100 per cent. egg-production. No significant difference was observed in the egg-production of the two groups of hens; in the 16 weeks following infestation, the egg-production of the infested hens was 76 per cent. and that of the uninfested, 75·7. From the 17th week after infestation the protein content of the feed in five infested and five uninfested pens was reduced from 16 to 12 per cent. without effect on the egg-production over a period of six weeks. The lice were removed at the end of the 22nd week, and the egg records of these hens for the next four weeks did not increase. The percentages of eggs fertile and chicks saleable produced were not adversely affected by the infestation. Two adults of *M. stramineus* were placed on each of 192 chicks five days old, and an equal number were left uninfested. There was no significant difference in weight gained or in the conversion of feed to weight in the two groups after a period of eight weeks.

RADELEFF (R. D.), NICKERSON (W. J.) & WELLS (R. W.). **Acute toxic effects upon livestock and meat and milk residues of dieldrin.**—*J. econ. Ent.* **53** no. 3 pp. 425–429. Menasha, Wis., 1960.

In 1949 and 1950, investigations were carried out in Texas to determine the toxicity of dieldrin to livestock and the extent to which residues of this insecticide accumulate in the meat and milk of cattle. Acute symptoms of poisoning, often followed by death, were produced by the insecticide administered as a spray at 0·25 per cent. to young calves and 2 per cent. to cattle, as a 3 per cent. dip to young lambs, and as a 4 per cent. spray or dip to sheep and goats. Lower concentrations of dieldrin did not produce toxic symptoms in the animals, and horses were not affected by 1 per cent. sprays. When administered orally as a drench or by a stomach tube, dieldrin produced poisoning in young calves when applied at a rate of 10 mg. per kg. body weight, in young pigs at 50 mg., and in young sheep and horses at 25 mg.; lower dosages were not toxic. Analysis of the omental fat of certain of the calves and cattle, and of other cattle given three 0·5 per cent. sprays in five weeks or eight 0·25 per cent. sprays at intervals of three weeks, showed 8–146 parts dieldrin per million, but the quantities found after the single treatments could not be related directly to the intensity of the effect of the toxicant on the animal. Milk showed maxima of 4·2 and 8·3 p.p.m. dieldrin on the second day after cows had been treated with 0·5 per cent. sprays of a wettable powder suspension and of a xylene emulsion, respectively. The residues of dieldrin in the omental fat fell to less than 1 p.p.m. 24 weeks after the last of the three 0·5 per cent. sprays and 16 weeks after the last of the eight 0·25 per cent. sprays, and in the milk to less than 0·2 p.p.m. in five weeks.

SHERMAN (M.) & ROSS (E.). **Toxicity to house fly larvae of droppings from chickens fed insecticide-treated rations.**—*J. econ. Ent.* **53** no. 3 pp. 429–432, 6 refs. Menasha, Wis., 1960.

The following is substantially the authors' abstract. Investigations were carried out on the effects of placing larvae of *Musca domestica* L. in the droppings of fowls kept on a diet containing coumaphos (Co-Ral), diazinon, trichlorphon (Dipterex), malathion, phenothiazine, fenchlorphos (ronnel) or Dow ET-15 [O-methyl O-2,4,5-trichlorophenyl phosphoramidothioate] [*cf.* *R.A.E.*, B **48** 196]. Coumaphos at 89 parts per million in the feed, diazinon at 154 p.p.m., trichlorphon at 89–132 p.p.m., fenchlorphos at 176–220 p.p.m., and Dow ET-15 at 89 p.p.m. killed more than 90 per cent. of the larvae. The droppings of chickens fed on rations treated with malathion or phenothiazine at concentrations of 1,102 and 11,023 p.p.m., respectively, killed only 78·8 and 45·3 per cent. of the larvae.

GRANETT (P.). **Use of an animal membrane in the evaluation of chemical repellents against the stable fly.**—*J. econ. Ent.* **53** no. 3 pp. 432–435, 1 fig., 4 refs. Menasha, Wis., 1960.

An apparatus was developed for evaluating the repellency of chemicals to *Stomoxys calcitrans* (L.) in the laboratory. The flies were exposed to the treated side of a membrane, derived from ox caecum, the other side of which was in contact with warmed beef blood [*cf.* *R.A.E.*, B **48** 120, etc.]. Repellency was determined by counting the number of flies that fed, and counting was facilitated by adding to the blood a fluorescent dye that shone in ultraviolet light. Adults of *S. calcitrans* were exposed to five repellents, butoxy polypropylene glycol (Crag Fly Repellent), N,N-diethyl-m-toluamide (Delphene), Indalone, MGK R-326 (di-n-propyl isocinchomeronate) or Tabutrex (di-n-butyl succinate) on ox caecum membrane or on cheesecloth [*cf.* **42** 4], and the results were compared. Repellency of all five materials varied with the surface to which they were applied; the RC50 of butoxy polypropylene glycol was 2·6 per cent. on ox caecum but greater than 10 per cent. on cheesecloth. The results of field tests of four of these chemicals sprayed on cattle against *Siphona irritans* (L.) and *Stomoxys* agreed more closely with the results obtained with the membranes than with those obtained with cheesecloth. In the field tests, the percentage repellency of butoxy polypropylene glycol remained above 80 per cent. for six hours and that of a mixture of MGK R-326 and MGK-264 [N-(2-ethylhexyl)bicyclo(2.2.1)-5-heptene-2,3-dicarboximide] was reduced to 60 per cent. in two hours; this was as effective as Delphene on the day of application and somewhat more effective on the next day; Tabutrex was the least effective.

Blum (M. S.) & Pratt jr. (J. J.). **Relationships between structure and insecticidal activity of some organotin compounds.**—*J. econ. Ent.* **53** no. 3 pp. 445–448, 12 refs. Menasha, Wis., 1960.

The results are given of experiments in which stannic chloride and 42 organotin compounds, mostly in acetone solution, were applied topically to adult females of *Musca domestica* L. of a susceptible strain. The LD50's were determined so far as possible and expressed in moles, in order to compensate for the large variations in molecular weight due to the diversity of the organic radicals present.

It was found that stannic chloride and two stannous carboxylates were almost non-toxic at the maximum dosage tested (12 μg. per fly), as also were phenyltin trichloride and n-butyltin-tri(2-ethylhexanoate), but replacing one of the anionic groups in the latter with an aryl or alkyl radical, respectively, to form the diphenyl and di-n-butyl compounds, increased toxicity; all dialkyl tin dichlorides showed some toxicity, with dimethyltin dichloride the most effective, and as some of these differed significantly in toxicity from the corresponding dialkyl tin carboxylates, it seems that the nature of the anion influences the toxicity of the compound. Tetra-substituted organotin compounds did not show much insecticidal activity and approached the di-substituted compounds in effect. The molar LD50 decreased fairly regularly as the chain length increased from one to eight carbon atoms, tetra-n-octyltin being the best, and replacing two of the four methyl groups in tetramethyltin with two vinyl groups had no effect, but replacing the four ethyl groups in tetraethyltin with four vinyl groups destroyed toxicity. Tetraphenyltin showed practically no toxicity, probably owing to poor penetration of the insect cuticle. Tri-substituted organotins were the most toxic of the compounds studied [*cf. R.A.E.*, B **46** 47], and triphenyltin chloride, which was the only significantly toxic aryltin derivative tested, was the best of them, though the difference was slight. The anion appeared to have less effect on toxicity in these than in the diorganotin series, though the presence of sulphur possibly increased toxicity, and their relatively uniform activity possibly indicates that the composition of the cation has little effect, insecticidal activity being correlated with the presence of three organic groups on the tetrahedral structure of the tin atom. Asymmetrical, unsaturated trialkyltin compounds containing one or two vinyl radicals (with the exception of one containing anionic fluorine, which confers properties that are more inorganic than organic) were of the same order of toxicity as saturated and symmetrical ones. Hexa-n-butyl distannane resembles a tetraorganotin and was non-toxic, and bis(tri-n-butyltin)oxide, which is susceptible to hydrolysis and ionisation and has low mammalian toxicity, was highly toxic to house-flies. This indicates that the biochemical fate of this compound differs in mammals and insects, and suggests the possibility of finding other selectively toxic organotin compounds.

Bruce (W. N.), Moore III (S.) & Decker (G. C.). **Face fly control.**—*J. econ. Ent.* **53** no. 3 pp. 450–451. Menasha, Wis., 1960.

As neither large-scale applications of insecticides giving deposits on outside resting sites nor saturation spraying of cattle proved effective against *Musca autumnalis* Deg., which had become numerous in northern Illinois during the summer of 1959, tests were carried out on the effectiveness of applying, by brush, baits of 75 per cent. maize syrup and 25 per cent. water containing diazinon, dimethoate or dichlorvos (DDVP) to the foreheads of the animals at an average of 3 ml. per animal. Baits containing 1 per cent. diazinon as emulsion concentrate or wettable powder caused about 50 per cent. reduction in the number of flies per beast, and those containing 1 per cent. dimethoate and 0·1 per cent. dichlorvos caused reductions of 83·3–92·4 and 97·5–98·4 per cent., respectively. When applied daily for the first week and then at intervals of 2–5 days, baits containing mixtures of 0·2 per cent. dichlorvos and 1 per cent. dimethoate caused 94·8–99·3 per cent. reduction after 21 days. Baits applied in the evening were less effective than those applied in the morning, which gave excellent control throughout the day and became dry enough by evening to withstand moisture and dew during the night.

Ebeling (W.). **Control of the tropical rat mite.**—*J. econ. Ent.* **53** no. 3 pp. 475–476, 1 fig., 6 refs. Menasha, Wis., 1960.

Experiments were carried out in California on the effectiveness of a silica aerogel [*cf. R.A.E.*, A **47** 379; B **48** 207] for the control of *Ornithonyssus* (*Bdellonyssus*) *bacoti* (Hirst) in six houses in which the inhabitants had been attacked by this mite [*cf.* **44** 44, 158]. The aerogel, containing 4·7 per cent. ammonium fluosilicate, was blown into the attics of the houses at the rate of 1 lb. per 1,000 sq. ft., and also into the space under four of the houses. The dust was also applied under mattresses, to furniture, and to any places likely to shelter the mites. In five of the buildings, infestation ceased immediately after treatment and did not recur, the periods since treatment ranging from six weeks to one year. In the sixth house, a woman was attacked by *O. bacoti* after the treatment; more dust was applied to areas not treated previously and no reinfestation occurred. It is reported that similar treatment was successful for the control of mites migrating from birds' nests into houses.

Johnson (W. T.) & Langford (G. S.). **Residual effectiveness of certain insecticides in horn fly control.**—*J. econ. Ent.* **53** no. 3 pp. 477–478. Menasha, Wis., 1960.

Tests were conducted in Maryland in 1959 on the duration of effectiveness of deposits of malathion, Sevin, methoxy-DDT (methoxychlor) and dimethoate applied to cattle as sprays or dusts for the control of *Siphona irritans* (L.). Each animal received 1 U.S. pint of spray containing about 0·5 per cent. active ingredient, or quantities of dust providing similar amounts of active ingredient. The numbers of *S. irritans* were counted before treatment and every other day after it until six counts had been made or until the fly population had reached pre-treatment level. Malathion, fenchlorphos, dimethoate and Sevin were effective against *S. irritans* in either dusts or sprays. Of the dusts, fenchlorphos and dimethoate gave control for 12 days, malathion for 8–10 and Sevin for 8. The sprays generally were not effective for as long as the dusts. Observations over four years showed that methoxy-DDT as a spray or dust rarely remained effective for more than 12 days.

MINKIN (J. L.) & SCOTT (H. G.). **House fly pupation under baseboards.**—*J. econ. Ent.* **53** no. 3 pp. 479–480, 2 figs., 1 ref. Menasha, Wis., 1960.

In October 1959, adults of *Musca domestica* L. persisted in a guineapig house in Georgia when outside fly populations were at a low level, and investigation revealed large numbers of pupae under the skirting-boards. In a sample of 1 U.S. quart of these pupae, collected in a few minutes, about 20 per cent. were found to be alive, and adult flies were seen emerging from pupae under the boards. It was assumed that adults of *M. domestica* had oviposited in waste trays under the animal cages and that the larvae had developed in them; full-fed, these had crawled across the floor and, failing to find more suitable places, had pupated under the skirting-boards. The routine weekly cleaning of cages had failed to eliminate the flies because, with the temperature controlled at 70–72°F., larval development was completed in about six days. Control of flies was maintained in adjacent buildings with cords impregnated with 10 per cent. parathion installed at the rate of 30 linear ft. per 100 sq. ft. of floor space [*cf. R.A.E.*, B **44** 127; **46** 43], and deposits from sprays of 5 per cent. DDT or malathion and 12·5 per cent. sugar applied at 1 U.S. gal. per 950 sq. ft.

KELLEN (W. R.) & LEWALLEN (L. L.). **Response of mosquito larvae to** *Bacillus thuringiensis* **Berliner.**—*J. Insect Path.* **2** no. 3 pp. 305–307. New York, N.Y., 1960.

Although tests already noticed indicated that *Bacillus thuringiensis* might be pathogenic to mosquito larvae [*R.A.E.*, B **48** 223], Thuricide, a commercial product incorporating spores of this bacillus, was useless against larvae of *Aëdes nigromaculis* (Ludl.) in laboratory and small-scale field experiments in California and those of *Culex tarsalis* Coq. in the laboratory. Much of the mortality caused in the laboratory appeared to be due to the diluents or impurities included in the product, and little or no kill was given by unadulterated spores.

WELCH (H. E.). **Effects of Protozoan parasites and commensals on larvae of the mosquito** *Aedes communis* **(DeGeer) (Diptera: Culicidae) at Churchill, Manitoba.**—*J. Insect Path.* **2** no. 4 pp. 386–395, 3 figs., 17 refs. New York, N.Y., 1960.

Three species of Protozoa were found in association with larvae of *Aëdes communis* (Deg.) at Churchill, Manitoba, in 1952–53. One was *Thelohania* sp., which killed the larvae by infecting the fat-body and preventing pupation and caused 3–11 per cent. mortality in forest pools. The others were common on the larvae but caused little or no harm to them.

BRIGGS (J. D.). **Reduction of adult house-fly emergence by the effects of** *Bacillus* **spp. on the development of immature forms.**—*J. Insect Path.* **2** no. 4 pp. 418–432, 3 refs. New York, N.Y., 1960.

The following is virtually the author's summary. A filterable principle produced in nutrient-broth cultures of *Bacillus thuringiensis* var. *thuringiensis* was found to interfere with the development of *Musca domestica* L., reducing the number of adults issuing from a treated larval substrate. A similarly acting, but weaker principle was found in cultures of *B. cereus*. Activity of the filterable principle is retained in spore powders. Laboratory and commercially produced spore preparations of *B. thuringiensis* var. *thuringiensis* retained activity in the droppings of chickens receiving daily amounts of a preparation in rations with and without antibiotics (aureomycin and sulfaquinoxaline). Application of a preparation as an additive to chicken feed resulted in 99 per cent. reduction of adult fly emergence when 3 g. per day was consumed by laying hens. No deleterious effects on the hens, or on the quantity or quality of their eggs, were noted as a result of the regular consumption of a laboratory or a commercially produced spore preparation.

Curtis (L. C.). **Control of the Rocky Mountain wood tick,** *Dermacentor andersoni* **Stiles (Acarina: Ixodidae), with ground sprays of dieldrin and heptachlor.**—*Proc. ent. Soc. B. C.* **56** pp. 13–15, 12 refs. Kamloops, B.C., 1959.

In tests in British Columbia in 1956–57, the numbers of *Dermacentor andersoni* Stiles on artificially infested range plots were very greatly reduced within three weeks by sprays of dieldrin or heptachlor at 1 lb. in 40 gal. emulsion spray per acre.

Chabaud (M. A.) & Ovazza (M.). **La fièvre jaune dans la Fédération d'Éthiopie et d'Érythrée. Nouvelles données épidémiologiques.**—*Bull. World Hlth Org.* **19** no. 1 pp. 7–21, 3 maps, 11 refs. Geneva, 1958. (With a summary in English.)

An epidemiological survey of yellow fever was made from March 1953 to March 1955 in the Federation of Ethiopia and Eritrea. Of the 509 sera collected from eight provinces, only seven, all from Assab, Eritrea, gave positive results in mouse protection tests and nine were doubtful. Two of the seven positive sera were from children 10–14 years old and one each from the age-groups comprising children 5–9 and 2–4 years old. *Aëdes aegypti* (L.) had reached a maximum density of one per four rooms in houses in Assab in 1951–52 and then declined. It was seldom found in houses during the present survey, and no potential vectors were taken at Assab either as larvae or adults. Except for a few individuals caught in dwellings at Akobo, Ethiopia, at an altitude of 1,800 ft. and a few at Gorgora at about 5,600 ft., adults of the subgenus *Stegomyia*, including *A. aegypti*, were generally found outdoors. Species known to transmit yellow fever elsewhere or suspected of being able to do so were found in most of the surveyed regions below 6,600 ft., but no evidence of endemicity was found at these lower altitudes.

McMahon (J. P.), Highton (R. B.) & Goiny (H.). **The eradication of** *Simulium neavei* **from Kenya.**—*Bull. World Hlth Org.* **19** no. 1 pp. 75–107, 3 figs., 18 refs. Geneva, 1958. (With a summary in French.)

In Kenya, onchocercosis [caused by *Onchocerca volvulus*] is confined to Nyanza Province where it occurs in three districts. The vector, *Simulium neavei* Roub., was eradicated from the Kodera focus in 1946 [*R.A.E.*, B **35** 109], and its distribution in the whole Province, which has an area of over 14,000 sq. miles, was then examined with a view to complete eradication. It became evident that control must be directed against the larval stage, as the wooded nature of the country made measures against the adult impracticable. First attempts failed, owing to incomplete knowledge of the bionomics of the Simuliid, but early in 1950, the immature stages of *S. neavei* were found in phoretic association with the crab, *Potamon* (*Potamonautes*) *niloticum* [**40** 5]. A re-survey showed that many tributaries and small streams in forested areas where adults of *S. neavei* were previously taken in abundance did not harbour the immature stages, whereas rivers outside the forests did. In 1952–53 in South Nyanza and in 1954 and 1956 in North Nyanza, infested streams and rivers were treated with DDT for 30 minutes, generally nine times at intervals of ten days, at a dosage to give a final concentration of 0·5 part per million in the rivers [**48** 34–35] and 1 p.p.m. or more in streams at each application. Calculations were based on discharge at the outfall, and not at the dosing point. The optimum time for beginning treatment was 2–3 weeks before the end of the long rains. It was often necessary to make supplementary treatments below swamps towards the end of the campaign, and such treatments were also made below dams or semi-stagnant pools. The measures taken are believed to have been effective in virtually eradicating *S. neavei* from Kenya. No adult or larva of this species has been found since the campaign, except that a focus of infestation is known to remain contiguous with an infested zone on the western slopes of Mount Elgon in Uganda; this is being dealt with by the Uganda authorities.

In addition to the account of the campaign contained in the main body of this paper, information on the effect of DDT on crabs, fish and aquatic insects and on a technique for checking results by means of artificially infested crabs, the timing of check surveys in relation to river speeds, other species of Simuliids associated with *P. niloticum* [**45** 186], freshwater crabs in Kenya rivers [*cf.* **48** 146] and larviciding equipment is given in appendices.

ANTONIPULLE (P.), DAVID (H. V.) & KARUNARATNE (M. D. R.). **Biology and control of** *Taeniorhynchus* (*Mansonioides*) *uniformis* **Theobald, the chief vector of rural filariasis in Ceylon.**—*Bull. World Hlth Org.* **19** no. 2 pp. 285–295, 8 refs. Geneva, 1958. (With a summary in French.)

The eradication of *Pistia stratiotes*, with which mosquitos of the subgenus *Mansonioides* of *Mansonia* are associated, reduced rural filariasis (caused by *Brugia* (*Wuchereria*) *malayi*) in Travancore [*R.A.E.*, B **27** 46], but destruction of this plant in Ceylon did not eliminate *Mansonia* (*Taeniorhynchus*) *uniformis* (Theo.), the main vector of *B. malayi* there. As *Salvinia cucullata*, another host-plant of species of *Mansonioides*, proved difficult to eliminate, experiments were carried out in a village on the west coast of Ceylon on the control of *M. uniformis* with DDT. The houses bordered low-lying areas covered with aquatic vegetation, most of which are used as rice-fields in May–August and October–January. Dwellings and outhouses were sprayed with DDT at a rate of 85 mg. per sq. ft. of wall surface in December 1953 and in August 1954. At both times, the mosquito population decreased considerably immediately after spraying, and the intervals that elapsed between the applications and the capture of the first mosquitos infected with *B. malayi* were 12 and 32 weeks, the percentage infected not reaching 5 after the first spraying or 6 during the 64 weeks after the second; the percentage infected before the application was 24 [*cf.* **45** 26]. During these investigations, observations on the bionomics of *M. uniformis* were made.

The immature stages were found on 11 species of aquatic plants, the egg-masses on the leaves and the larvae and pupae attached to the roots; *Isachne australis* was the commonest and was the chief host-plant, there being no *Pistia* or *Salvinia* in the area. A sieve with 20 meshes per inch, which was fine enough to hold the larvae but did not retain much mud, held under the roots of the plants, was found useful for the collection of the larvae, which tended to detach themselves from the roots at the slightest disturbance. The adults, which fly into buildings at night, feeding on man and animals between dusk and dawn, but mainly before 9 p.m., preferred day-time resting places that were slightly damp, shady and sheltered, away from dwellings. They were attracted to artificial light and were caught in greater numbers during periods of moonlight; mating activity was observed to increase at the full moon. An increase in *M. uniformis* was observed to coincide with the onset of the north-east and south-west monsoons, when the rice-fields were inundated and overgrown with *I. australis*.

Hocking (B.). **Further considerations regarding the repellency of spray components.**—*Bull. ent. Res.* **52** pt. 1 pp. 1–5, 13 refs. London, 1961.

The following is largely based on the author's summary. Several components of insecticidal sprays have an undesirable repellent effect on the insects they are designed to kill, and the T-tube apparatus previously used to demonstrate the repellency of DDT, fuel oil and an auxiliary solvent containing methylated naphthalene [*R.A.E.*, B **47** 24] towards certain Diptera was used again, with modifications, in further studies of olfactory repellency designed to identify the ingredients responsible. Consideration was also given to the possibility of finding substitutes with less repellent or even attractive properties. Light, medium and heavy fractions obtained by fractional distillation of fuel oil, two methylated-naphthalene auxiliary solvents and other materials were tested against *Drosophila melanogaster* Mg., *Musca domestica* L. or *Aëdes aegypti* (L.), air saturated with the vapours of these substances being generally used whenever volatility was high enough to allow this. The repellency of the more volatile compounds was inversely related to boiling point, and appears to be non-specific both as to insects [*loc. cit.*] and among related chemicals, so that the degree of repellency depends on the volatility and hence the concentration. This was borne out by a decrease in repellency in later tests with the same material and by a reduction in the repellency of both acetone and tetrahydronaphthalene at 50 per cent. saturation.

However, tests of materials of such low volatility that it was not possible to saturate the air (benzyl benzoate with *M. domestica* and dimethyl phthalate and butoxy polypropylene glycol with *M. domestica* and *A. aegypti*) showed equally clearly that there is no simple broad relation between volatility and repellency. They indicated rather the existence of a vapour concentration of maximum olfactory attractiveness for each substance or class of substances. This was suggested by Dethier in a work already noticed [**36** 149]; as concentration rises above the critical level, attractiveness decreases until it is replaced by repellency, and this in turn increases with further rises in concentration. Butoxy polypropylene glycol, widely used as a repellent in livestock sprays, showed consistent olfactory attractiveness to *M. domestica* and *A. aegypti*; its action as a repellent was thought to be attributable to differences in the behaviour of insects, effects of combination with other ingredients, stimulation of a rejection fibre in gustatory receptors or to a general chemical sense. The odour of *D. melanogaster* was attractive to other members of the species, and since this was regardless of sex, it was a species effect.

There appears to be little prospect that an economic non-repellent material will be found. It is suggested that the repellency of spray components might be counteracted by the addition of specific attractants, sex or other, to spray formulae. Alternatively, a useful repellent space spray, containing no toxicant, might be formulated from the lighter fractions of the solvent materials.

Hocking (K. S.). **Discriminative application of insecticide against** *Glossina morsitans* **Westw.**—*Bull. ent. Res.* **52** pt. 1 pp. 17–22, 2 figs., 3 refs. London, 1961.

The following is largely based on the author's summary. An emulsion spray containing 3 per cent. (w/v) dieldrin was applied once to the putative resting places of *Glossina morsitans* Westw. throughout a comparatively isolated fly-belt 17 sq. miles in extent in the Kabiganda Valley in south-western Uganda between October 1957 and November 1958. Concentration areas of the fly, determined by searches for resting flies, were found to consist of one or more tall acacia trees (*Acacia gerrardii*) with associated understorey and thicket. Savannah species of tsetse have been found to rest during the day on the undersides of horizontal branches [*R.A.E.*, B **48** 152, etc.]. The undersides of the branches of the trees, which averaged 6·75 per acre, were therefore sprayed up to a height of about 10 ft. with dieldrin at about 0·2 lb. per acre. Chemical analysis showed a deposit of about 0·8 g. dieldrin per sq. metre on the surface sprayed, and although 90 per cent. of this had disappeared from the surface after about four months, it is thought that the application remained effective for this period. A very great reduction in the tsetse population was achieved. Spraying of the thickets in the concentration sites instead of the trees was not more effective and was more costly in time and insecticide. Small numbers of flies continued to be caught, but it was thought possible that these were being brought in from neighbouring valleys by buffalo, and, hence, that insecticidal treatment of this sort, if carried out over a wide enough area, might eradicate a tsetse population.

Gillett (J. D.). **Laboratory observations on the life-history and ethology of** *Mansonia* **mosquitos.**—*Bull. ent. Res.* **52** pt. 1 pp. 23–30, 1 fig., 29 refs. London, 1961.

An account is given of the rearing of a complete generation of *Mansonia* (*Coquillettidia*) *aurites* (Theo.) from eggs laid by a blood-fed female caught on 1st October 1949 in the Lunyo Forest, near Entebbe, Uganda. Larvae hatched four days after oviposition and fastened themselves to roots of *Commelina* sp. This plant develops a new and vigorous root-system within a few hours of the submergence of the lower end of a severed stem, survives for many months and has a long straight habit that makes it particularly suitable for the rearing of larvae, isolated in their fourth instar, in separate tubes. Dog-biscuit and Bemax were provided as food. About 10 per cent. of the total reached the pupal stage, and the adults emerged in December. Variation in the leg ornamentation of these adults developed from a single egg-raft was found to cover the whole range usually observed in the species.

Reference is made to inconsistency in the use of terms describing aggregations of mosquito eggs, and it is proposed that eggs laid by a single female following a single ovarian cycle should be called a batch, a batch of eggs aggregated by cohesion (whether laid on the underside of floating leaves or as a typical raft on the water surface) should be called a cluster, and more than one batch of eggs (including clusters) in any given area, a mass. Differences in egg-raft shape shown by some Ethiopian species of the subgenus *Coquillettidia* are discussed, and a tentative key, based on the shape of the raft, is given for separating the species studied in sufficient detail.

Reid (J. A.). **The attraction of mosquitos by human or animal baits in relation to the transmission of disease.**—*Bull. ent. Res.* **52** pt. 1 pp. 43–62, 35 refs. London, 1961.

Experiments were made in three different areas of Malaya between 1952 and 1957 to compare the numbers of mosquitos of various species attracted to man and to calf or goat under the same conditions. The baits being compared (either two men and one calf or two men and two goats) were exposed simultaneously in two net traps about 20–50 yards apart. This procedure is referred to as comparative trapping. Flaps in the nets were lowered once an hour from 7 p.m. to 11 p.m. and the trapped mosquitos were caught; the flaps were then usually opened again and a further catch made at 5.30 a.m. In the first area, a small tongue of land between two tidal creeks fringed by mangrove forest, the dark-winged form of *Anopheles barbirostris* Wulp [*R.A.E.*, B **34** 32] was the vector of malaria. In the second, which was similar but less shady and more susceptible to brackish inundation, the vector was *A. sundaicus* (Rdnw.). In the third area, a lowland tea estate, the vectors were *A. letifer* Sandosham and *A. umbrosus* (Theo.), species that bred in or on the edge of the freshwater swamp forest that surrounded the estate.

In the first area, nearly four times as many adults of *A. barbirostris* were caught in the man-baited as in the calf-baited net and nearly six times as many as in the net with goats. All other Anophelines were attracted in much larger numbers to the animals than to the men. *A. barbirostris* formed about 78 per cent. of Anopheline catches with human bait but only 2–3 per cent. of those with animal bait. In the second area, *A. sundaicus*, which was not present in the first, was considerably more attracted by the calf than by the men, but came in much greater numbers to man than to goats. However, it formed 69 and 67 per cent. of the Anopheline catches on human bait compared with 25 and 13 per cent. of those with calf and goats. The numbers of *A. barbirostris*, especially the dark-winged form, were small, but the trial with man and goat suggests a considerable difference in the responses of the two forms, the light-winged form seldom going to man. All the Anophelines in the third area came in larger numbers to the calf than to the men, and the malaria vectors, *A. letifer* and *A. umbrosus*, together formed only 43 per cent. of the Anophelines caught with human bait, whereas *A. separatus* (Leic.) composed half. However, *A. separatus* formed 80 and *A. letifer* and *A. umbrosus* together only 13 per cent. of the Anopheline catch on calf.

The total number of mosquitos caught with each bait in all areas showed calf to be much the most attractive, followed by goats and then man. To compare the host preferences of the different species as between man and calf, the numbers of each caught with man and with calf were expressed as a ratio (the man : calf attraction ratio). For most species, the ratios of host preferences from the different areas were much the same, showing that the method produced repeatable results, and the data from the three areas are therefore combined. Ratios ranged from 3·4 : 1 in favour of man for the dark-winged form of *A. barbirostris* to 1 : 82 in favour of calf for *A. vagus* Dön., those of the other malaria vectors being 1 : 1·6–7·1. In addition to dark-winged *A. barbirostris*, two other species, *Aëdes albopictus* (Skuse) and *Culex pipiens fatigans* Wied., were attracted in larger numbers to man than to calf, the ratios being 2·5 and 1·7 : 1, and six species, including these three and *Anopheles sundaicus*, were caught in larger numbers with man than with goat. As in the malaria vectors, comparatively high man : calf attraction ratios (ranging between 3·4 : 1 and 1 : 11) were found in the local vectors of *Wuchereria bancrofti* (*C. p. fatigans* [**49** 98]) and *Brugia* (*Wuchereria*) *malayi* (*A. barbirostris* and various species of *Mansonia* [**47** 5; **48** 186, 232]), in *A. albopictus*, which is a laboratory vector of dengue and in species from which the virus of Japanese B encephalitis has recently been isolated locally by Traub (*Culex gelidus* Theo. and *C. tritaeniorhynchus* Giles [*cf.* **45** 197], *M. uniformis* (Theo.) and *Aëdes butleri* Theo.). *C. gelidus* and *C. tritaeniorhynchus*, the two most important vectors of the Japanese B virus, are more attracted to calf than are the malaria vectors, as might be expected from the fact that the disease appears principally to affect animals.

Attraction ratios calculated from suitable data published by various authors for ten different species in five countries are also given. Those for the Anophelines place these in an order that agrees well with their status as malaria vectors. It appears that if the results of comparative trapping are expressed as attraction ratios, this offers a method of comparing the host preference of mosquitos of the same or different species, at different times and places in a country, or even in different countries; precipitin tests, which reveal the actual blood-feeding pattern of mosquitos at a particular time or place, are not very satisfactory for comparing preferences at different places and at different times, since their results are influenced by the availability of suitable hosts [*cf.* **48** 88]. Window-trap huts [*cf.* **41** 162] seemed to magnify any bias shown in net traps, but the order in which the species were placed by the ratios remained the same.

CHAPMAN (R. F.). **Some experiments to determine the methods used in host-finding by the tsetse fly,** *Glossina medicorum* **Austen.**—*Bull. ent. Res.* **52** pt. 1 pp. 83–97, 10 figs., 9 refs. London, 1961.

The following is mainly based on the author's summary. An account is given of field and laboratory experiments carried out at Accra in Ghana to determine the senses used by *Glossina medicorum* Aust., which was common in the area [*R.A.E.*, B **49** 19] to locate its host. A model locomotive, with a black screen (about 1 ft. × 6 in.) attached so that only it was visible to the fly, was used to simulate the host in laboratory experiments on vision. The locomotive ran in a circle on rails in an illuminated observation box, and a fly was placed in a stoppered flask in the centre, about 1 ft. from the screen. The flies, which were kept under conditions that eliminated vibration as far as possible, were stimulated to move by the movement of the screen; when the screen was stopped and started for short periods, the increase in activity became less each time the screen was put in motion, but fell off less rapidly than in experiments in which the screen was kept moving. The possible significance of this is discussed in the light of the normal habitat of the species. In the field, adults of *G. medicorum* did not respond to a black screen (about 4 × 3 ft.) drawn across their field of vision at a distance of more than 25 ft., but those of *G. morsitans* Westw., collected in northern Ghana, responded well at distances of up to 150 ft., irrespective of the presence or absence of sunlight. Tethered adults of *G. medicorum* were attracted in the laboratory to the small screen and showed a preference for landing on the lower edge near the centre.

A guineapig and a goat used as sources of smell in laboratory experiments produced no response from the flies, and this was thought to be due to their unsuitability as hosts; but the vapour of dilute acetic acid elicited a strong reaction. In field experiments, there was a very marked response to the smell of cows that were not visible to the fly. Orientation to a source of smell probably involves orientation to air movement, and *G. medicorum* showed a strong tendency to fly upwind in a wind tunnel, even when blinded. It is concluded that, unlike the savannah species *G. morsitans* and *G. swynnertoni* Aust., which can see considerable distances [*cf.* **26** 74], *G. medicorum*, which lives in thicket or forest where visibility is poor, probably responds initially to the smell of a potential host. An upwind orientation would then bring it to the general vicinity of the animal, and the final approach might be visual.

Gillies (M. T.). **Studies on the dispersion and survival of *Anopheles gambiae* Giles in East Africa, by means of marking and release experiments.**—*Bull. ent. Res.* **52** pt. 1 pp. 99–127, 2 pls., 9 figs., 15 refs. London, 1961.

The following is largely based on the author's summary. An account is given of marking, release and recapture experiments with *Anopheles gambiae* Giles in a coastal area of Tanganyika. The mosquitos were laboratory-reared and were labelled either by the topical application of paint or by the introduction of radioisotopes into the larval breeding pans. Two different isotope solutions were used, ^{32}P as an orthophosphate and ^{35}S as a sulphate, and recaptures were recognised by autoradiography. For this, the mosquitos were attached to cellulose tape stretched over a numbered grid, particulars of the catch were attached, and the mosquitos on the tape were exposed for about 40 hours on X-ray film. It was usually easy to distinguish the diffused fogging produced by mosquitos labelled with ^{32}P from the sharp images of those labelled with ^{35}S. If, however, there was doubt, the mosquitos were re-exposed on double layers of film. Those treated with ^{32}P left images on both films and those labelled with ^{35}S only on the one with which they were in direct contact. Use was also made of an observation by W. G. Duncombe that objects labelled with ^{35}S leave an image on one side only of film that is coated with emulsion on both sides. Rearing in radioactive solutions had no effect on the survival or fertility of the adults. Marking with paints caused some mortality in the first 24 hours but none thereafter. Mosquitos were always released within three days and usually within two days of emergence. Routine catching stations were established in one house out of five in a circular area with a radius of 1¼ miles, and mosquitos were released either in the centre or near the periphery of the area, so that recaptures were possible up to a maximum of 2¼ miles away.

Of 132,450 mosquitos released, 1,019 were recaptured. The mean flight range of males and females released in the centre was estimated to be 0·52 and 0·64 mile, respectively, and that of females released on the periphery, 0·98; individuals of both sexes were caught at the maximum range of 2¼ miles. The distribution of recaptured mosquitos indicated that dispersion was not random but was related primarily to the density of the human population, being less where the concentration of houses was high; the direction of the prevailing wind had a definite effect in certain series of releases, but this was in general a minor factor. Dispersion during the first day or sometimes the first two days after release was more restricted than it was later, but no difference in the distribution of catches was detected between mosquitos recaptured 3–9 days after release and those taken later. Marked females were recaptured up to 23 days after release. Apart from the first two days, the regression of density on age amounted to a daily loss of 16 per cent. of mosquitos from the experimental area. The effect of emigration could not be assessed quantitatively, but was thought to be a minor component of the total daily loss. The relatively high level of mortality suggested by these figures [*cf. R.A.E.*, B **43** 62] is attributed to the use of laboratory-reared mosquitos. Further confirmation of high mortality was obtained from the fact that the corrected sporozoite rate in marked females at the time of recapture was only 0·8 per cent., whereas the sporozoite rate in wild-caught females in the area averaged 5–7 per cent. over all seasons. Survival of males was only slightly lower than that of females. It is concluded from the survival curve that the mortality rate remained constant throughout the period in which marked females were recovered.

SMITH (I. M.) & RENNISON (B. D.). **Studies of the sampling of *Glossina pallidipes* Aust. I. The numbers caught daily on cattle, in Morris traps and on a fly-round.**—*Bull. ent. Res.* **52** pt. 1 pp. 165–182, 3 figs., 28 refs. London, 1961. **II. The daily pattern of flies caught on cattle, in Morris traps and on a fly-round.**—*T. c.* pp. 183–189, 2 graphs, 15 refs.

An account is given in the first paper of two experiments in south-eastern Uganda in which adults of *Glossina pallidipes* Aust. were caught on tethered, small Zebu oxen and in Morris traps [*R.A.E.*, B **49** 20–21, etc.], daily for two periods in March–April 1957, in early wet-season conditions, and for one period in March 1958, under late dry-season conditions. Catches were also made on a fly-round two or three times weekly before, during and after each experiment. Only non-teneral adults were considered in the study of the results. Fewer were caught in traps than on oxen, but the proportion of females was much higher in the traps. Catches tended to be greater in traps covered with natural-coloured hessian than in others on which the hessian was painted black [*cf.* **49** 21]. A white ox attracted fewer flies than a red, a black or a red and white one, and among the latter, the red was the most attractive. The sexes were not equally influenced by the factors controlling activity and availability to the oxen and the traps, and this strengthens the view that the behaviour pattern of the two sexes is different. The numbers caught by the various methods were, in general, not correlated, and this casts doubt on the validity of fly-round or trap data as estimates of the number of adults of *G. pallidipes* likely to attack cattle, and the fact that the fly-round data suggested a difference in population density at the two seasons, whereas the ox and trap catches, which operated over a wider range of variations in fly activity, suggested no such difference, indicates that fly-round data may give an unsatisfactory measure of the true population density [*cf.* **34** 197].

The fluctuations in the catches throughout the day, as shown by records for every 1½-hour period between 8 a.m. and 6.30 p.m. each day during the two experiments, are discussed in the second paper. The pattern of catching throughout the day by the three methods strengthened the conclusion that neither fly-rounds nor traps provided a particularly appropriate method for estimating the threat to cattle. The following is virtually the authors' summary of the results. Flies were attracted to the oxen in greater numbers in the morning and evening than at midday, the evening increase being marked in the wet season. The daily catches of both sexes on oxen, though starting at much the same levels in both seasons, fell to lower levels at the hotter times of day during the dry season and rose only slightly in the evening. Traps, on the other hand, in both seasons caught most females between 12.30 and 2 p.m. and least in the mornings. Male flies were trapped in greatest numbers between 2 and 3.30 p.m. in the wet season, but only in comparatively small numbers at any time in the dry season, though there was then a suggestion of maximum availability between 11 a.m. and 12.30 p.m. Catches on the fly-round and on oxen showed a similar periodicity during the dry season in the case of females, but not in that of males, fly-round catches of these declining from a peak at 9.30–11 a.m.

WALLIS (R. C.). **Diapause and fat body formation by** *Culex restuans* **Theobald (Diptera, Culicidae).**—*Proc. ent. Soc. Wash.* **61** no. 5 pp. 219–222, 7 refs. Washington, D.C., 1959.

The following is substantially the author's summary. Diapause and fat-body formation in *Culex restuans* Theo. were studied in Connecticut from 1956 to 1959. In the field, the incidence of blood-fed females was high in spring and summer, but declined rapidly in the autumn, when hibernation places were filled with large populations of young adults. These females, instead of containing blood, were filled with a clear fluid and developed fat-bodies. Females of laboratory colonies reared during the summer became reluctant to take blood in the autumn and developed a preference for engorgement on sucrose solution. Sucrose-fed females, when put in experimental hibernation conditions, developed fat-bodies without having previously taken blood. The good survival of these females was contrasted with poor survival and unsuccessful hibernation of blood-fed females.

ZELEDÓN (R.). **Sobre la biología del** *Telenomus fariai* **Lima, 1927 (Hymenoptera: Scelionidae), parásito endófago de huevos de algunos Triatominae.** [On the biology of *T. fariai*, an endophagous parasite of the eggs of some Triatomines.]—*Rev. Biol. trop.* **5** fasc. 1 pp. 1–16, 1 pl., 4 figs., 7 refs. San José, Costa Rica, 1957. (With a summary in English.)

A study was made of the bionomics of *Telenomus fariai* Costa Lima, which was found parasitising the eggs of *Triatoma phyllosoma* (Burm.) in a laboratory in El Salvador, and the following is taken from the author's summary and conclusions. Under experimental conditions, the Scelionid parasitised eggs of *T. dimidiata* (Latr.), *T. phyllosoma*, *Panstrongylus chinai* (Del Ponte) and *P. megistus* (Burm.) [*cf. R.A.E.*, B **15** 235; **17** 53], but not those of *T. infestans* (Klug), *Rhodnius prolixus* Stål or *R. pallescens* Barber. A close relation was found between the mean numbers of the Scelionid developing per egg and the size of the eggs of *T. phyllosoma*, *T. dimidiata* and *P. chinai*. At 30°C. [86°F.], complete development of *Telenomus* was obtained in 19 days in eggs of *P. chinai*, and in 20 days in those of *Triatoma phyllosoma*; at room temperature, development took 32–42 days. Host eggs were dissected just before the adult parasites left them, and groups of females were separated after various periods; females separated during the hour after initial contact with the males reproduced parthenogenetically.

ZELEDÓN (R.). **Algunas observaciones sobre la biología de la** *Dermatobia hominis* **(L. jr.) y el problema del tórsalo en Costa Rica.** [Observations on the bionomics of *D. hominis* and the problem represented by it in Costa Rica.]—*Rev. Biol. trop.* **5** fasc. 1 pp. 63–74, 1 pl., 1 graph, 16 refs. San José, Costa Rica, 1957. (With a summary in English.)

The following is based largely on the author's summary of this account of observations on the bionomics of *Dermatobia hominis* (L. jr.) in Costa Rica [*cf. R.A.E.*, B **49** 74, etc.]. *Stomoxys calcitrans* (L.) is an important carrier of the eggs in some areas where *Dermatobia* is abundant. No differences were observed in the ability of full-fed larvae to pupate in damp soil, dry soil, wood shavings and blotting paper in flasks, or in their viability in the various media. The substrate seemed to act simply as an absorbent of the excess liquid that the larva eliminates in the period that precedes the formation of the puparium. The larvae tend to bury themselves, probably to avoid the excessive heat of the superficial soil layers; no adults developed from pupae kept at 32°C. [89·6°F.], and the minimal pupal period at 30°C. [86°F.] was reduced from 25 days at 26°C. [78·8°F.] to 20 days. Adults lived 4–12 days at room temperature; an increase in temperature decreased their life span to two days at 30°C. Pairing may begin on the day after emergence, and oviposition three days later. In the laboratory, larvae hatched from eggs laid on *Musca domestica* L. and from eggs on two captured adults of *S. calcitrans*, the incubation periods being 9, 9 and 8 days, respectively. Various animals were infested with these larvae, and the life-cycle was completed on a dog, the larval, pre-pupal and pupal stages lasting 33, 2 and 37 days, respectively.

PAPERS NOTICED BY TITLE ONLY.

BAKRI (G.). **Massenzucht der Stechfliege,** *Stomoxys calcitrans* **(L.) im Laboratorium.** [Mass breeding of *S. calcitrans* in the laboratory.]—*Z. angew. Zool.* **46** pt. 4 pp. 491–494, 3 refs. Berlin, 1959. (With a summary in English.) [*Cf. R.A.E.*, B **47** 78.]

BAKRI (G.). **Über die Vorzugstemperatur und Vorzugsfeuchtigkeit der Larven der drei** *Calliphora*-**Arten** *erythrocephala* **Mg.,** *vomitoria* **Mg. und** *uralensis* **Villen. (Diptera, Calliphoridae).** [On the preferred temperatures and humidities of the larvae of the three species of *Calliphora*—*vicina* R.-D. (*erythrocephala* (Mg.)), *vomitoria* (L.) and *uralensis*.]—*Z. angew. Zool.* **46** pt. 4 pp. 495–511, 8 figs., 8 refs. Berlin, 1959. (With a summary in English.)

HASSETT (C. C.), KIRK (R.) & CRAIG (G. B.). **Apparatus for insecticide assay** [using larvae of *Aëdes aegypti* (L.)].—*J. econ. Ent.* **53** no. 3 p. 483, 1 fig., 2 refs. Menasha, Wis., 1960. [*Cf. R.A.E.*, A **49** 308.]

BUÉI (K.). **Effects of population density on the development of the common house fly larvae,** *Musca domestica vicina* **Macq.** [*In Japanese.*]—*Botyu-Kagaku* **23** pt. 4 pp. 173–176, 1 graph, 7 refs. Kyoto, 1958. (With a summary in English.)

WILLIAMS (R. W.). [A list of] **The reported biting and filth frequenting arthropods of the Bermuda Islands exclusive of the Ixodoidea and Araneida** [and including the first record of *Linognathus setosus* (van Olfers) from the Bermudas].—*Proc. ent. Soc. Wash.* **61** no. 5 pp. 234–238, 11 refs. Washington, D.C., 1959.

LUTTA (A. S.) & SHUL'MAN (R. E.). **The influence of microclimatic conditions of the meadow and forest on the survival and activity of the tick** *Ixodes ricinus* **L.** [*In Russian.*]—*Zool. Zh.* **37** pt. 12 pp. 1813–1822, 6 graphs, 30 refs. Moscow, 1958. (With a summary in English.)

WHARTON (R. H.) & ABU HASSAN BIN OMAR. **The effect of house spraying with dieldrin on the incidence of the head-louse,** *Pediculus humanus capitis.*—*Med. J. Malaya* **13** no. 3 pp. 237–238, 1 ref. Singapore, 1959.

A reduction in the incidence of *Pediculus humanus capitis* Deg., which is very high in rural populations in Malaya, resulted from spraying houses with dieldrin for the control of vectors of filariasis in Ubai, East Pahang, in 1954. After five months, no lice were found in the hair of girls from this area, whereas 65 per cent. of those examined in a neighbouring unsprayed area were infested. The dieldrin sprays were continued at six-monthly intervals and extended to another area, Pulau Rusa, in 1957. In 1958, no head lice were recovered from children living in either area, though empty eggs were found in the hair of a few girls from both.

REID (J. A.) & LIM (C. S.). **A note on the residual life of the insecticide malathion.**—*Med. J. Malaya* **13** no. 3 pp. 239–242, 1 graph, 5 refs. Singapore, 1959.

In Malaya, adults of *Aëdes aegypti* (L.) were confined in batches of 20 on wooden walls at various intervals after these had been treated with malathion at 100 or 50 mg. per sq. ft. Both doses remained effective for three months, the kill 24 hours after exposure being about 60 per cent., but in the fourth month the kill fell sharply with both doses and was nil by the sixth month.

OPPENOORTH (F. J.) & VAN ASPEREN (K.). **Allelic genes in the housefly producing modified enzymes that cause organophosphate resistance.**—*Science* **132** no. 3422 pp. 298–299. Lancaster, Pa., 1960. (Abstr. in *Insecticide Newslett.* **9** no. 12 p. 357. Ottawa, 1960.)

In all of six phosphate-resistant strains of *Musca domestica* L. a mutant gene is present that produces an altered aliesterase. The modified enzymes are no longer irreversibly inhibited by the oxygen analogues of the insecticides to which the strains are resistant but can slowly convert them [*R.A.E.*, B **49** 77]. In five of the strains the resistance is caused by this gene only.

KARTMAN (L.). **The role of rabbits in sylvatic plague epidemiology, with special attention to human cases in New Mexico and use of the fluorescent antibody technique for detection of** *Pasteurella pestis* **in field specimens.**—*Zoonoses Res.* **1** no. 1 pp. 1–27, 1 map, 4 pp. refs. New York, N.Y., 1960.

Rabbits were not considered to be important in the epidemiology of sylvatic plague in the United States or to be subject to epizootic outbreaks before 1950. In that year, however, a case of plague occurred in New Mexico in a man who had shot and skinned six cottontail rabbits (*Sylvilagus audubonii*), and the survey that followed showed plague infections in the carcasses of two individuals of *S. audubonii* found nearby and in two pools of seven and 11 individuals, respectively, of *Hoplopsyllus glacialis* (Tasch.) and two of *Echidnophaga gallinacea* (Westw.) from the two carcasses. Four more cases of human plague associated with handling of *S. audubonii* occurred in New Mexico in 1951, 1959 and 1960. Evidence of transmission by fleas in cases of plague attributable to contact with rabbits in the United States is, however, lacking, and there is no evidence that rabbits constitute basic reservoirs of the disease or are affected significantly except during rodent epizootics.

HART (C. B.) & MALONE (J. C.). **The occurrence of the rabbit fur mite,** *Cheyletiella parasitivorax* (**Megnin, 1878) on the dog.**—*Vet. Rec.* **70** no. 49 pp. 991–993, 2 figs., 9 refs. London, 1958.

Four puppies at different places in southern England were found to be infested by *Cheyletiella parasitivorax* (Mégn.) [*cf. R.A.E.*, B **31** 80] in 1955–57, and concurrent dermatitis occurred in five people associated with them [*cf.* **39** 38]. Scaly lesions developed on the dogs soon after their purchase, and on examination *C. parasitivorax* was found: two of the dogs came from kennels where cats and rabbits were also kept [*cf.* **38** 190]. The infestation was controlled on two of the dogs by two applications of an aqueous suspension of 0·125 per cent. technical BHC, and on the third by two applications of dilute benzyl benzoate emulsion. The fourth dog was treated with BHC and appeared to be recovering but was destroyed before completion of the treatment. The owners of three of the dogs developed papulous lesions on the arms, neck and trunk within two weeks of purchasing the animals, and medical opinion was that the condition was due to infestation by mites. Treatment with benzyl benzoate emulsion gave fairly rapid response. The two owners of the fourth dog developed skin irritation on the arms, neck and chest. It is suggested that *Cheyletiella* fed on the mammalian host in the absence of the small mites on which it normally feeds.

HORSFALL (W. R.). **New use for an old formulation: spot suppression of mosquitoes.**—*Pest Control* **27** no. 4 p. 24. Painesville, Ohio, 1959.
LOPP (O. V.) & BUCHANAN (W. J.). **How granular mosquito repellent performed in the field.**—*T.c.* pp. 25–26, 2 figs.

The following paragraphs are, respectively, abstracts of these two papers, in which accounts are given of the application of dry granular formulations for the prevention of annoyance by mosquitos in small areas in Illinois.

When applied to grass and shrubbery at a rate of 10 lb. per acre, a formulation that has been used as a larvicide, and contains vermiculite, a petroleum fraction and DDT, suppressed most of the activities of mosquitos (*Aëdes* and *Psorophora*), including feeding, for up to four days, the mosquitos not leaving the vegetation unless disturbed. The mode of action of the mixture is unknown but is presumably one of disorientation; the best evidence that the effect was not one of repellence was that, when the formulation was applied at 10 lb. per acre, *Aëdes vexans* (Mg.) continued to oviposit at the same rate on the treated as on the untreated areas.

In 1958, two plots, each one acre in size and about 2,000 ft. apart, were treated with 10 lb. of a mixture of vermiculite and solvent with and without 10 per cent. DDT, respectively, and a third similar plot was left untreated. Counts made of the mosquitos landing before and after treatment showed that the mixture of vermiculite and solvent gave greater reduction in the numbers of mosquitos landing than the mixture containing DDT. By the seventh day after treatment, reinvasion by mosquitos began to occur. In a second test, similar formulations were applied by turbine blower to three plots of six acres, two acres and half an acre, respectively, and landing rates of mosquitos observed before and after treatment showed that, as in the first test, the mixture of carrier and solvent gave greater reduction in the number of mosquitos landing than the mixture containing DDT. Reinvasion by mosquitos began to occur by the fifth day after treatment.

DOBROTWORSKY (N. V.). **Notes on Australian mosquitoes (Diptera, Culicidae). IV.** *Aëdes alboannulatus* **complex in Victoria.**—*Proc. Linn. Soc. N. S. W.* **84** pt. 1 pp. 131–145, 4 figs., 4 refs. Sydney, 1959.

A study of the complex of *Aëdes alboannulatus* (Macq.) in Victoria showed that it consists of six forms. These are *A. alboannulatus* itself and *A. queenslandis* (Strickl.), for both of which morphological data are given, and four other forms not hitherto differentiated from the latter. One of these, previously recorded by Lee, Dyce & O'Gower in a paper already noticed [*R.A.E.*, B **47** 179], is here referred to as Form A and is considered a distinct species but is not described or discussed. Two of the others are described from adults of both sexes and larvae as *A. rupestris*, sp. n., and *A. tubbutiensis*, sp. n., and the egg of the former is also described. The remaining variant, referred to as the " yellow form ", does not appear to be reproductively isolated from *A. queenslandis* and is treated as a variety of it. The larva and egg are described, and distinguishing characters are given for the adult. Keys are given to the adults of the five species and the larvae of the four named ones. *A. rupestris* is known from Victoria and southern Queensland, and *A. tubbutiensis* from Victoria only. Although both it and *A. queenslandis* vary considerably, there is no continuous gradation between them.

A. alboannulatus occurs almost throughout Victoria. It is a sylvan species, breeding in ground and rock pools usually in diffuse sunlight. The eggs survive desiccation through the summer. *A. queenslandis* and *A. rupestris* are also woodland species and both breed in pools [*loc. cit.*] but show different temperature preferences. A study in 1955–58 showed that rocky pools in shallow rapids provided permanent breeding sites for *A. rupestris* even during the summer when the temperature of the water may exceed 30°C. [86°F.], but the cooler pools in the surrounding forest were never used. The latter were the permanent breeding places of *A. queenslandis*, which also used the exposed rock pools in the cooler months and occasionally the deeper ones in the summer. Larvae of this species have not been found in Victoria in water with a temperature above 18°C. [64·4°F.]. When females of the two species were given the choice of water at 14–15°C. [57·2–59°F.] and 30°C., *A. queenslandis* laid 563 eggs in the cooler water and none in the warmer, and *A. rupestris* 1,347 in the warmer and none in the cooler. Given a choice of water at 17–18° and 27°C. [62·6–64·4 and 80·6°F.], females of *A. rupestris* laid 150 eggs in the former and 278 in the latter. *A. queenslandis* would therefore not normally deposit eggs on the edge of exposed rock pools during summer, whereas *A. rupestris* would prefer these sites. Exposure of the eggs to desiccation showed that the fully embryonated eggs of *A. queenslandis* could not withstand two days on filter paper at 54–58 per cent. relative humidity, whereas *A. rupestris* could do so. Eggs of *A. queenslandis* with young embryos withstood desiccation better, but not so well as did those of *A. rupestris*. When put on wicks of filter paper half an inch above water level at 17–18°C., no eggs of *A. rupestris* hatched, but 56 per cent. of those of *A. queenslandis* did, and the larvae were able to reach the water. Hatching of eggs of *A. queenslandis* above water-level might often be fatal for the emerging larvae in summer, and those that succeeded in reaching the water of the receding rock pools would be exposed to temperatures of 30°C. or more, which would probably be unfavourable for their development. *A. queenslandis* is abundant in the cooler parts of south-eastern Australia, but *A. rupestris* has been less successful in the south. Rock pools exposed to the sun are not common in Victoria, and the distribution of this species is very patchy. The two are sympatric, but no intermediates have been found. Both bite man readily, but *A. rupestris* ceases to do so earlier in the year than *A. queenslandis*. *A. tubbutiensis* appears to have a very restricted distribution. Little is known about its biology and ecology, and adults were not collected in nature, but it is evidently more adaptable to high temperatures than is *A. queenslandis*. It breeds mainly in ground pools, occasionally in rock pools, in the full sunlight or exposed to the sun for part of the day.

Weidhaas (D. E.), Gahan (J. B.) & Ford (H. R.). **Effect of temperature, aeration, pH, and the presence of soil on the toxicity of various insecticides to mosquito larvae.**—*Florida Ent.* **42** no. 3 pp. 105–108, 4 refs. Gainesville, Fla., 1959.

The effectiveness of water-soluble insecticides introduced into irrigation water as it flows into the fields for the control of flood-water mosquitos (*Aëdes* spp.) decreases over long distances of flow and in shallow water [*cf. R.A.E.*, B **45** 4, 193]. Laboratory studies were therefore made to determine the factors responsible. Fourth-instar larvae of *Anopheles quadrimaculatus* Say were used as test insects. Distilled water, to which acetone solutions of four organophosphorus insecticides at about twice the LC100 (parathion at 0·02, malathion at 0·5, diazinon at 0·05 and trichlorphon (Dipterex) at 0·5 parts per million) had been added, was kept for 24 hours under various conditions of temperature and pH, and under aeration, and the larvae were then introduced and mortality was determined after a further 24 hours. Controls for all test conditions were kept in treated water that had been aged for 24 hours at 80°F. Aging at pH 8 or 9 did not greatly reduce the toxicity of any of the materials. Aeration greatly decreased the toxicity of diazinon and slightly decreased that of malathion, but did not affect parathion or trichlorphon. The toxicity of trichlorphon was reduced by aging at 130°F. but not at 120°, and the toxicity of parathion was reduced at 130° but only slightly at 120° or 110°, that of malathion at 120° but not at 110° and that of diazinon at both 110° and 120°.

The effect of aging for 24 hours over 50 g. sand or Florida soil was then tested on 50, 100 and 150 ml. water treated with 0·02 p.p.m. parathion from an acetone solution or a 1:4 mixture with Triton X-100. After the water had aged, 25 larvae in 25 ml. distilled water were put into each test jar, and mortality was observed after 24 hours. Treated water lost little toxicity over sand, but there was a large loss in the presence of soil. This was greater if the water and soil were shaken together, but even when the soil was kept still and covered with filter paper, mortality was lower with the Triton-X formulation than with the acetone. It was also lower if the water was shallow. In a similar experiment with acetone solutions of the four insecticides and heavy California clay under filter paper, all the insecticides lost toxicity in the two smaller volumes of water. In a final test in which some 20 insecticides were tested as acetone solutions in water over Florida soil protected by filter paper, two materials, 2,4-dimethylbenzyl chrysanthemate and 2,4-dimethylbenzyl 2,2-dimethyl-3-(2-methylpropyl)cyclopropanecarboxylate, showed no loss of toxicity after aging for 24 hours.

Davis (A. N.), Weidhaas (D. E.) & Ford (H. R.). **Relative susceptibility of salt-marsh mosquitoes from Georgia and Florida to insecticides.**—*Florida Ent.* **42** no. 3 pp. 109–111, 3 refs. Gainesville, Fla., 1959.

Comparisons were made of the susceptibility to insecticides of salt-marsh mosquitos from parts of Florida, where chlorinated hydrocarbons had been used against larvae and adults for 11 years, and from a locality in Georgia, where there had been only sporadic treatments with a DDT fog. Determination of LC90's by exposure of fourth-instar larvae of mixed populations of *Aëdes taeniorhynchus* (Wied.) and *A. sollicitans* (Wlk.) in water containing DDT, BHC, dieldrin, malathion, parathion, coumaphos (Bayer 21/199), diazinon or trichlorphon (Dipterex) at 0·0005–0·25 parts per million, showed the Georgia larvae to be 8–10 times as susceptible to DDT, BHC and dieldrin as the Florida larvae but not more than twice as susceptible to any of the organophosphorus compounds. Batches of salt-marsh mosquitos from the two States, mainly *A. taeniorhynchus*, were exposed within 72 hours of emergence in batches of 25–30, without distinction of sex, to atomised solutions of DDT, BHC and malathion at 0·005–2 per cent. in odourless kerosene in a wind tunnel. The adults from Georgia were 7·8 times as susceptible to DDT as those from Florida, but there was little difference in the susceptibilities to BHC, and the Florida mosquitos were 2·4 times as susceptible to malathion as those from Georgia.

LEWALLEN (L. L.). **Toxicity of several organophosphorus insecticides to** *Gambusia affinis* **(Baird and Girard) in laboratory tests.**—*Mosq. News* **19** no. 1 pp. 1–2, 3 refs. Albany, N.Y., 1959.

Gambusia affinis is an efficient predator of mosquito larvae and pupae, and experiments were carried out in California on the effects on the fish of eight insecticides in comparison with malathion and parathion, those most widely used in mosquito control. For the tests, the compounds were made up as 1 per cent. w/v solutions in acetone, and diluted to dosages that corresponded to the 24-hour LC90 for fourth-instar larvae of *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.). Ten fish were exposed to 5 ml. solution in 500 ml. distilled water. Phorate (Thimet), azinphos-methyl (Guthion) and malathion at 0·05 part per million and parathion at 0·004 p.p.m. caused 70–90, 30–80, 30–50 and 30–40 per cent. mortality, respectively, of *Gambusia*, Trithion, fenchlorphos (Korlan), Delnav [2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)] and Dibrom [dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate], at 0·2, 0·1, 0·05 and 0·03 p.p.m., respectively, caused 20 per cent. or less, and the two other materials, trichlorphon (Dylox) and one of unspecified composition, at 0·5 and 0·05 p.p.m., respectively, caused no kill [*cf. R.A.E.*, B **48** 184].

WISEMAN (J. S.), GRIMES (J. E.) & EADS (R. B.). **St. Louis encephalitis outbreak in Cameron County, Texas.**—*Mosq. News* **19** no. 1 pp. 3–7, 1 fig., 5 refs. Albany, N.Y., 1959.

The following is virtually the authors' summary. During investigations of the St. Louis encephalitis epidemic that occurred in Cameron County, Texas, in August 1957, a total of 1,900 mosquitos were collected, 85 per cent. of which were *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.). St. Louis encephalitis virus was isolated from eight pools of *C. p. fatigans* [*cf. R.A.E.*, B **47** 7]. In December 1957 and January, April and May 1958, 3,082 mosquitos were collected and processed in 61 pools, but no virus was isolated.

LEWALLEN (L. L.) & NICHOLSON (L. M.). **Parathion-resistant** *Aedes nigromaculis* **in California.**—*Mosq. News* **19** no. 1 pp. 12–14, 1 ref. Albany, N.Y., 1959.

Tests were carried out in California on the toxicity of parathion to fourth-instar larvae of *Aëdes nigromaculis* (Ludl.) reared from eggs laid by females collected from two areas where insecticides had not been applied for mosquito control and from two where difficulty in obtaining control with parathion had been reported. Solutions of the insecticide in acetone were made in a range of concentrations that killed 5–95 per cent. of the larvae in 24 hours. One ml. of the solution was pipetted into a paper cup containing 20 larvae in 100 ml. of distilled water, and the LC50's and LC90's were determined after 24 hours. At the LC50 level, the strains from the districts where parathion had failed were about twice and three times as resistant to parathion as the suspectible strains, and at the LC90 level, they were about 68 and 25 times, respectively, as resistant. In limited tests with one susceptible and one resistant strain of *A. nigromaculis*, the results indicated cross-resistance to fenchlorphos (Korlan) and Trithion, but not to malathion or azinphos-methyl (Guthion).

OLINGER (L. D.), DARROW (D. I.) & EDDY (G. W.). **Tests with esters of chrysanthemumic acid against larvae of the mosquito** *Culex tarsalis*.—*Mosq. News* **19** no. 1 pp. 15–16, 5 refs. Albany, N.Y., 1959.

As *Culex tarsalis* Coq. has developed resistance to malathion in California [*R.A.E.*, B **47** 198], evaluations were made of the effectiveness of 39 esters of chrysanthemic acid against fourth-instar larvae of a non-resistant strain of this mosquito. In each test, 25 larvae were exposed to the toxicants in acetone solutions added to 250 ml. distilled water in a 400 ml. beaker, and mortality was determined after 24 hours. Only 12 of the esters caused mortalities of 95–100 per cent. at concentrations of 1 part per million or less, and the two most effective were the 6-chloropiperonyl ester [barthrin] and the 6-bromopiperonyl ester, which both caused 100 per cent. mortality at 0·05 p.p.m. In tests with the 6-chloropiperonyl, 6-bromopiperonyl and piperonyl esters, fourth-instar larvae of strains of *C. tarsalis* resistant to malathion and DDT and to DDT alone showed some resistance to all three.

GAHAN (J. B.) & LABRECQUE (G. C.). **Residual effectiveness of three chrysanthemumates and two organophosphorus compounds against mosquitoes.**—*Mosq. News* **19** no. 1 pp. 19–20, 1 ref. Albany, N.Y., 1959.

The duration of effectiveness of deposits of six organophosphorus compounds against adults of a non-resistant colony of *Anopheles quadrimaculatus* Say has been reported [*R.A.E.*, B **48** 218], and similar tests with three esters of chrysanthemic acid and two organophosphorus compounds are described, using DDT as a standard for comparison. Acetone solutions of the compounds were sprayed on plywood panels at 100 mg. active ingredient per sq. ft., and the panels were tested after aging for 1–90 days. In each test, about 50 adults of *A. quadrimaculatus* were exposed to a treated panel, under a half petri dish, for periods ranging from 5 to 120 minutes, after which they were transferred to screen cages where they were provided with a 10 per cent. sugar solution and kept for 24-hour mortality counts. The 2,4-dimethylbenzyl chrysanthemate was the most effective compound for 60 days, but lost its toxicity after 90 days; it caused 100 per cent. mortality for 14 days after an exposure of 5 minutes. The 2-chloroethyl 2,2-dichlorovinyl ethyl phosphate was also highly effective for 30 days, but then lost its toxicity rapidly; it caused 100 per cent. mortality for 7 days after an exposure of 5 minutes and for 14 days after an exposure of 15 minutes. Exposures of 60–120 minutes were required to obtain similar results with DDT, but this level of effectiveness was maintained for 90 days, whereas no other compound killed more than 12 per cent. after this period. Barthrin (6-chloropiperonyl chrysanthemate) was about equal to DDT for 14–30 days. The 6-bromopiperonyl chrysanthemate was the least effective of the chrysanthemic acid esters, and azinphos-methyl (Guthion) was ineffective after one day.

O'Connor jr. (C. T.). **The role of *Mochlonyx cinctipes* (Coquillett) in the reduction of woodland pool mosquitos in Ohio (Diptera: Culicidae).**—*Mosq. News* **19** no. 1 pp. 21–22, 7 refs. Albany, N.Y., 1959.

In laboratory feeding tests, third- and fourth-instar larvae of *Mochlonyx cinctipes* (Coq.) were observed to consume 3–4 first- or second-instar larvae of *Aëdes aegypti* (L.) in a day, and a study was made of the potentialities of this Chaoborid as a predator of mosquitos in semi-permanent woodland pools in Ohio. It was found that several factors mitigated predation in the field, one being the relative size of the prey. Thus the more rapid growth of larvae of *A. stimulans* (Wlk.), the most abundant species in the pools, which resulted in their showing a greater average length in each larval instar than *Mochlonyx*, tended to inhibit the predatory action of the latter. Furthermore, *M. cinctipes* is polyphagous, and of 80 third- and fourth-instar larvae collected from pools, only two contained remains of mosquitos. These factors, and the sparse distribution of *Mochlonyx*, make the latter economically unimportant in the control of the mosquitos of woodland pools.

Hosoi (T.). **Identification of blood components which induce gorging of the mosquito.**—*J. Insect Physiol.* **3** no. 3 pp. 191–218, 5 figs., 39 refs. London, 1959.

The following is virtually the author's abstract. The peculiar stimulation of mosquitos by host blood, which usually ensures gorging and subsequent dispatch of the food to the midgut, may be supposed to be either tactile or gustatory. From examination of various properties of dietary blood for their effects on the feeding responses of *Culex pipiens pallens* Coq., evidence was obtained that the blood stimulants are predominantly chemical, and that the responsible substance or substances must be some components of the erythrocytes as well as of other living cells, rather than the fluid part of the blood, but that it is neither haemoglobin nor any other compounds heretofore suspected. The blood stimulus, though exceedingly acceptable to the mosquito, differs qualitatively from that of sugars. Sodium chloride and similar inorganic chlorides in adequate concentrations exhibit a slight degree of the blood-like stimulation. They are obviously rejected at higher concentrations. Osmotic pressure has no fundamental influence upon sugar feeding but can affect blood feeding, since hypotonic solutions of haemolysed erythrocytes are refused by the insect if they are not sweetened with sugar. As a result of such findings, it was possible to extract from ox blood cells a substance possessing the action of the blood stimulus. Through ion-exchange chromatographic separation, this was identified as adenylic acid. Comparison of the effects of several nucleotides and their related compounds suggests that adenosine-5-phosphates of blood cells afford the main stimulus that promotes gorging of the mosquito on a blood-meal. Acceptability of the other compounds is also discussed in relation to their chemical structure.

Heslop (J. P.) & Ray (J. W.). **The reaction of the cockroach** *Periplaneta americana* **L. to bodily stress and DDT.**—*J. Insect Physiol.* **3** no. 4 pp. 395–401, 2 graphs, 10 refs. London, 1959.

The following is virtually the authors' abstract. The effects of DDT and bodily stress upon the oxygen consumption and neuromuscular system of *Periplaneta americana* (L.) were investigated and compared. Tolerance of DDT in two strains of the cockroach was shown to be correlated with tolerance of stress. A tentative hypothesis as to the course of the insects' reaction to poisoning and to stress is put forward and briefly discussed.

Liles (J. N.) & DeLong (D. M.). **The longevity and productivity of adult male and female** *Aedes aegypti* **when reared separately and together on three different diets.**—*Ann. ent. Soc. Amer.* **53** no. 2 pp. 277–280, 4 graphs, 7 refs. College Park, Md., 1960.

The following is virtually the authors' abstract. In the laboratory experiments described, adult females of *Aëdes aegypti* (L.) lived longer than males, whether the sexes were reared separately or together, and whether they were fed on 10 per cent. sucrose, on citrated haemolysed beef blood containing 10 per cent. sucrose, or on a synthetic diet of amino acids, inorganic salts and 10 per cent. sucrose. In all cases, males lived significantly longer alone than when caged with females, but females lived longer with males than when alone, except on the blood diet, where the life spans were relatively equivalent. On blood, females of the mixed group laid 2·3 times as many eggs as were laid by the isolated group of virgin females. On the sucrose diet, the length of life of males and of females, whether separated or together, was as great as or greater than on either of the other two diets. On the blood diet, eggs deposited in 40 days averaged 300 per fertilised female and 127 per virgin female, while on the synthetic diet the averages were 47 and 7·4, respectively.

Hadjinicolaou (J.). **Present status of** *Phlebotomus* **in certain areas of Greece.**—*Bull. World Hlth Org.* **19** no. 6 pp. 967–979, 1 fig., 4 refs. Geneva, 1958. (With a summary in French.)

The following is largely based on the author's summary. A survey of the *Phlebotomus* populations of the city of Athens and its suburbs, the islands of the Saronikos gulf, the island of Euboea, the District of Lakonia in southern Peloponnesus, and Crete was carried out in the summer of 1957. Houses, stables and other suitable shelters were searched. Sandflies were found to have practically died out in all areas in which systematic spraying with DDT or other chlorinated-hydrocarbon insecticides had been carried out since the inception of the intensive Anopheline control programme in 1946 [*cf. R.A.E.*, B **40** 159]. On the other hand, they were still plentiful in villages that had not been included in the programme, and fairly plentiful in unsprayed towns and cities. *P. papatasi* (Scop.) was the only species found in Athens, and by far the predominant species in most other areas, including Crete. Susceptibility tests on *P. papatasi*, in which the sandflies were exposed for one hour to papers impregnated with different amounts of insecticide from constant volumes of oil solutions of various concentrations, showed an LC50 for DDT of 0·28 per cent. at Athens and 0·75 per cent. at Chania in Crete. No explanation is offered for the difference, as only space sprays had been used in both localities. The LC50 for dieldrin at Athens and in Euboea was about 0·2 per cent.

Busvine (J. R.). **Insecticide-resistance in bed-bugs.**—*Bull. World Hlth Org.* **19** no. 6 pp. 1041–1052, 1 fig., 17 refs. Geneva, 1958. (With a summary in French.)

To measure insecticide-resistance in bed-bugs (*Cimex*), batches of adults of a susceptible and a suspected resistant strain of *C. lectularius* L. and of a susceptible and four suspected resistant strains of *C. hemipterus* (F.) were put on small pieces of filter paper impregnated with oil solutions of insecticides, in test-tubes, and mortality was estimated after five days at 25°C. [77°F.]. The results obtained are tabulated, and it is concluded that two kinds of resistance can develop, either independently or in conjunction, in both these species. One involves DDT, methoxy-DDT (methoxychlor) and analogues, and was not overcome by the addition of an equal amount of DMC, as a synergist, so that there is no evidence of detoxification by dehydrochlorination [*cf. R.A.E.*, B **45** 171, etc.]; there were also indications of a resistance to pyrethrins in strains resistant to DDT [*cf.* **41** 159]. The other kind of resistance involves γ BHC, dieldrin and various other chlorinated cyclodiene insecticides. The resistance spectrum of a strain of *C. lectularius* from Israel [**45** 152] towards this group of compounds resembled those of *Anopheles gambiae* Giles [**49** 93] and *Musca domestica* L. [**44** 111–112], indicating similarity in the defence mechanism. The levels of resistance found in some of the strains did not appear to be in accordance with the information available from the use of the insecticides in the field [*cf.* **49** 94].

Brown (A. W. A.). **Laboratory studies on the behaviouristic resistance of** *Anopheles albimanus* **in Panama.**—*Bull. World Hlth Org.* **19** no. 6 pp. 1053–1061, 7 refs. Geneva, 1958. (With a summary in French.)

In 1952, it was observed that up to seven times as many adults of *Anopheles albimanus* Wied. were surviving house treatments with DDT at Gatuncillo on the Chagres River, Panama, as in 1945 and 1946, and there was evidence that resistance was behaviouristic [*R.A.E.*, B **42** 105]. House treatment twice yearly was continued from 1953 to 1958, when the reactions to DDT of two Chagres populations (from Gatuncillo and Santa Rosa) were compared with those of an untreated field population from Rio Gatun and a laboratory colony that had never been exposed to DDT. Lack of control had been noted on the Chagres in the intervening years. Experiments in which blood-fed females were exposed singly to a deposit of DDT on a vertical paper and the excitation time (time between settling and taking flight) was noted, showed that mean excitation times were about twice as long for the laboratory colony as for the field populations and that *A. albimanus*, as a species, remained in contact with treated surfaces for longer than did *A. gambiae* Giles or *A. funestus* Giles, in work already noticed [**41** 152–154], and much longer than *A. stephensi* List. [**41** 154]. The results also indicated that the Chagres populations were on the average more excited by DDT than the untreated field population, the difference being significant in the case of Gatuncillo and almost significant in that of Santa Rosa. However, since the differences are small and the frequency curves for the populations overlap, it is unlikely that they account completely for the behaviouristic resistance observed. There was no difference in susceptibility between the Chagres, untreated and laboratory strains when they were confined to DDT deposits for one hour.

Büttiker (W.). **Observations on the physiology of adult Anophelines in Asia.**—*Bull. World Hlth Org.* **19** no. 6 pp. 1063–1071, 18 refs. Geneva, 1958. (With a summary in French.)

Females of the same species of *Anopheles* may behave differently in the adverse season in different parts of their range, according to the climate. Where the winters are hard, hibernation, preceded by a blood-meal, is obligatory, the fat-body develops and feeding and ovulation cease. The author observed this pattern in *A. culicifacies* Giles in eastern Afghanistan in November 1956. Where the winters are short and mild, there is a state of semi-hibernation, in which relatively little fat-body is developed, meals are repeatedly taken and converted into fatty matter and sexual activity is often suspended in only a proportion of the population. This behaviour, which has been called gonotrophic discordance, has been recorded in *A. culicifacies* in eastern India. A third type of physiological behaviour, described in this paper, was observed by the author in *A. culicifacies* in northern Ceylon and central Burma and in *A. aconitus* Dön. in central Burma. At the beginning of the dry season, many females were practically devoid of fat reserves and showed no signs of ovarian development; their intestinal contents were coagulated, dark red and almost desiccated. It is believed that these females were in a state of partial quiescence or aestivation, maintaining themselves on their last blood-meal. It is likely that they would have to leave their shelters occasionally to obtain water. In Ceylon, females in this state were found in a tree hole and in uninhabited palm-leaf huts, which are considered particularly suitable for a period of quiescence. Catches in other localities from inhabited dwellings, which included palm-leaf huts but were unsuitable for passing a period of quiescence, did not yield any females in the condition described.

Gramiccia (G.), De Meillon (B.), Petrides (J.) & Ulrich (A. M.). **Resistance to DDT in** *Anopheles stephensi* **in southern Iraq.**—*Bull. World Hlth Org.* **19** no. 6 pp. 1102–1104, 1 ref. Geneva, 1958.

The susceptibility of *Anopheles stephensi* List. to DDT, dieldrin and γ BHC was studied in three villages of southern Iraq in October and November 1957. One village had been treated with DDT against larvae since about 1947 and against adults since 1954, and the second and third had been sprayed with DDT against adults since 1956 and April 1957, respectively, but had received no DDT as larvicide. The LC50's of DDT for adults were much more than 2 per cent. in all three villages and for larvae were 1, $>2\cdot5$ and >5 parts per million in the three villages, respectively. The development of resistance in the first village was not unexpected, but the degree of resistance found in the other two gives cause for great concern. All females that survived the tests were dissected and showed full ovarian development and no fat-body, and as males and larvae of all instars were also found, it is concluded that breeding was in progress and the resistance could not be attributed to hibernation. LC50's of dieldrin were 0·086–0·13 per cent. for adults, indicating no resistance, and $<0\cdot004$ p.p.m. for larvae and of γ BHC (in the first two villages) $<0\cdot02$ and 0·009 per cent. for adults and 0·08 and $<0\cdot1$ p.p.m. for larvae.

ARMSTRONG (J. A.). **The susceptibility of adult female** *Anopheles gambiae* **to insecticides in East Africa.**—*Bull. World Hlth Org.* **19** no. 6 pp. 1105–1109, 7 refs. Geneva, 1958.

Tabulated results are given of a survey of the susceptibility of females of *Anopheles gambiae* Giles to DDT, γ BHC and dieldrin in various parts of East Africa begun in 1955 in order to establish normal susceptibility as a standard for future comparison. The method used was that of Busvine & Nash [*R.A.E.*, B **41** 156]. Mosquitos from Mombasa, where a control scheme had been in progress for some years, from Gonja in a treated area of Tanganyika, and from an unsprayed area at Kisumu, Kenya, and wild-caught females from Zanzibar (as a pre-spray assessment) were tested in comparison with a laboratory colony for susceptibility to all three insecticides, and females from the untreated village of Magugu, Tanganyika, and from a sprayed area at Kisumu and bred material from Zanzibar were included for dieldrin. There was no evidence of any increase in mean tolerance above the levels present in the fully susceptible strains. LC50's of DDT ranged from 0·42 per cent. for the Gonja strain to 0·88 per cent. for wild-caught Zanzibar females (0·66 per cent. in the laboratory colony). LC50's of γ BHC ranged from 0·0039 per cent. for wild-caught Zanzibar females to 0·006 per cent. for the laboratory colony and of dieldrin from 0·02 per cent. for Mombasa females to 0·15 per cent. for the laboratory colony.

QUTUBUDDIN (M.). **The inheritance of DDT-resistance in a highly resistant strain of** *Aëdes aegypti* **(L.).**—*Bull. World Hlth Org.* **19** no. 6 pp. 1109–1112, 6 refs. Geneva, 1958.

Determination of the mortalities caused by different concentrations of DDT among fourth-instar larvae of a normally susceptible strain of *Aëdes aegypti* (L.) and a strain, designated the selected Trinidad strain, developed by selective laboratory exposure to DDT of the resistant Trinidad strain used by Busvine & Coker [*R.A.E.*, B **49** 94], showed that the LC50's of the susceptible strain and the selected Trinidad strain were 0·03 and 30 parts per million, respectively. Crossing experiments carried to the F_2 generation and back-crossing confirmed that resistance was monofactorial [**48** 237], and there seemed to be no linkage with sex.

DUPORT (M.) & SANDULESCO (M.). **Sensibilité de certains anophèles au DDT et au HCH en relation avec la saison et la température.**—*Bull. World Hlth Org.* **19** no. 6 pp. 1112–1115. Geneva, 1958.

The results are given of tests made by the method of Busvine & Nash [*R.A.E.*, B **41** 156] of the susceptibility of Rumanian Anophelines to insecticides in relation to season and temperature. The tests were carried out in places that had been sprayed with insecticides for a number of years and in others that had never been treated or had not received sprays for a few years. In the untreated locality of Agigea, where the Anopheline fauna was composed of 1·6 per cent. *Anopheles maculipennis maculipennis* Mg. (*typicus*), 1·9 per cent. *A. m. messeae* Flni., 68·7 per cent. *A. labranchiae atroparvus* van Thiel and 27·7 per cent. *A. sacharovi* Favr, the percentage mortalities caused by 0·5, 1, 2 and 4 per cent. DDT in August and (in brackets) October 1957 were 11·6 (0), 16·6 (0), 63·3 (10) and 100 (57·1). At Creata-Lesile, also untreated, where the composition of the fauna was

23·2 per cent. *A. m. maculipennis*, 51·4 per cent. *A. m. messeae* and 25·3 per cent. *A. l. atroparvus*, the corresponding figures were 9·9 (0), 34·2 (2), 73 (26) and 100 (68). Corresponding figures for 0·04 and 0·08 per cent. γ BHC at Agigea were 96 (0) and 100 (4·5). In populations from two localities, Saftica (another untreated locality, in which the Anopheline fauna was composed of 26·8 per cent. *A. m. maculipennis*, 68·3 per cent. *A. m. messeae* and 4·8 per cent. *A. l. atroparvus*) and Creata-Lesile, mortality caused by 0·5–4 per cent. DDT is stated to have been higher when the temperature was 3–6°C. [5·4–10·8°F.] higher. It was shown that Anophelines from localities in which deposit insecticides had been used for up to ten years had not become sufficiently resistant to survive in numbers adequate to transmit malaria, and this was confirmed by the very small numbers found in consistently treated localities and by the absence of the disease.

Thomson (R. C. Muirhead-). **A pit shelter for sampling outdoor mosquito populations.**—*Bull. World Hlth Org.* **19** no. 6 pp. 1116–1118, 8 refs. Geneva, 1958.

Various types of artificial outdoor shelters used in sampling mosquito populations are reviewed [*R.A.E.*, B **22** 65; **31** 52; **42** 28, 119], and a description is given of a pit shelter that was originally developed for use with *Anophcles gambiae* Giles and *A. funestus* Giles in Tanganyika, and has since proved very successful in Southern Rhodesia. A rectangular pit about 5–6 ft. deep, 4–5 ft. long and 3–4 ft. wide is dug in a shaded position near a village, and a little cavity about 1 ft. deep and with a horizontal roof is excavated in each of the four vertical sides about 1½–2 ft. from the bottom of the pit. These dark niches are most attractive to mosquitos as resting-sites provided the mouth of the main pit is shaded from above. As villages and animal enclosures are normally situated on well-drained ground, little trouble has been experienced from flooding. The pits have the advantage that they can be made on level ground and they provide a rapid and effective means of sampling an outdoor population of *A. gambiae*, particularly in areas where house catches have been very low and outdoor resting in natural haunts is very diffuse. The pits have also proved very attractive to members of the group of *A. funestus* Giles and to *A. demeilloni* Evans.

Büttiker (W.). **Notes on exophily in Anophelines in south-east Asia.**—*Bull. World Hlth Org.* **19** no. 6 pp. 1118–1123, 15 refs. Geneva, 1958.

A survey of potential outdoor Anopheline resting places was recently made in rural areas in parts of Ceylon, in which country the vector density had decreased in towns and villages as a result of repeated use of DDT sprays. The huts used by agricultural labourers, timber cutters and watchmen in temporary plantations were examined with the aid of pyrethrum knockdown sprays, the interiors having been made mosquito-proof with cotton sheeting, and it was shown that these improvised structures harboured considerable numbers of mosquitos. Cavities in trees yielded good catches, and large, accessible, vertical ones were examined in the same way as huts. Of 32 females of *Anopheles culicifacies* Giles taken in one such cavity in a tree about 100 yd. from a hamlet, eight were freshly engorged (one with bovine blood and none with human, goat, dog or pig blood), four were gravid and 20 were probably in aestivation, with old, hard stomach contents [*R.A.E.*, B **49** 142]. A survey of an area of over 1,000 sq. yd., in which there were 39 large trees, revealed six holes considered suitable resting-places for mosquitos. Examination of these in the dry season with the aid of pyrethrum spray yielded ten females of *A. culicifacies*, corresponding to a density of the order of 27,000 per sq. mile. A few Culicines were found in the exit holes of termite mounds and in birds' nests in sandy river-beds; the first were investigated by the introduction of a repellent after they had been closed with muslin gauze, and the second by the application of a pyrethrum spray and closure of the exits for ten minutes after strips of strong paper had been slipped along the bottom of the nests. Overhanging roots along river margins harboured *A. culicifacies*, but riverine thickets of palm (*Pandanus zeylanicus*) and rock caves did not.

It is concluded that exophily in Anophelines is more common than is usually supposed, and that considerable populations may rest outdoors, in a variety of circumstances [**46** 204], seeking shelter in such places as tree holes and bamboo clumps and on overhanging roots, shaded leaves and tree buttresses, whether near or remote from sprayed localities.

SMITH (A.). **Dieldrin-resistance in** *Cimex hemipterus* **Fabricius in the Pare area of north-east Tanganyika.**—*Bull. World Hlth Org.* **19** no. 6 pp. 1124–1125, 4 refs. Geneva, 1958.

In the Pare area of north-eastern Tanganyika, where an experiment was in progress to test the effects of house-spraying with dieldrin on the transmission of malaria [*R.A.E.*, B **48** 179–180], the first cycle of treatment at 80 mg. per sq. ft. from a water-dispersible powder was completed in November 1955, and subsequent treatments were made at half this rate. Beds were sprayed as well as the interior surfaces of the huts, and the first treatment gave immediate control of bed-bugs (*Cimex hemipterus* (F.)). No nuisance from bugs was reported after the second cycle in June 1956, but a recurrence was reported after the third in January 1957. Examination of 94, 106 and 108 beds in November 1955 (one week after the first treatment), in June 1957 (five months after the third) and in October 1957 (one week after the fourth) revealed that 5, 91 and 86 of the beds, respectively, were infested. In laboratory tests of susceptibility, in which batches of ten bugs, taken directly from infested beds between August and November 1957, were exposed to insecticide-impregnated filter papers (11 cm. in diameter) in test-tubes for seven days, dieldrin at concentrations up to 3 per cent. had no obvious effect on bugs from Pare, but at 0·1 per cent. or more gave complete control of bugs from an untreated area 30 miles away. Bugs from both areas appeared equally susceptible to DDT at concentrations of 0·7 per cent. or more, but at lower concentrations, survival was greater among bugs from Pare.

HUDSON (B. W.) & PRINCE (F. M.). **A method for large-scale rearing of the cat flea,** *Ctenocephalides felis felis* (**Bouché**).—*Bull. World Hlth Org.* **19** no. 6 pp. 1126–1129, 3 figs., 4 refs. Geneva, 1958.

A description is given of a flea-proof cage, suitable for continuous occupancy by a cat and used to produce very large numbers of *Ctenocephalides felis felis* (Bch.) in pure culture rapidly and economically for allergy studies. The cage has solid sheet-metal sides, a sheet-metal bottom in the shape of a shallow funnel ending in a glass jar, a top of ¼-in. hardware cloth and a removable platform of the same material to support the cat. Food trays are attached to the sides to reduce risk of spilling, and a tray of sawdust is provided. A medium for rearing larvae, consisting of 20- to 30-mesh pine sawdust mixed with 2–5 per cent. (by volume) of food (100 parts (by weight) ground dog-food, 10 parts dried brewers' yeast and 15 parts dried beef blood) is lightly sprinkled over the bottom of the cage. Once a week, the medium is swept into the jar, adult fleas are returned to the host, and the substrate, mixed with an equal amount of white sand, is sifted to remove coarse débris, enriched with additional food and stored at 80°F. and 80 per cent. relative humidity until pupation occurs. Pupae are transferred every 2–3 days to an emergence chamber. Egg production under these conditions reached about 28 per female per day in 7–8 days after emergence (6–7 days after the first blood-meal) and remained constant for at least two weeks.

RODENWALDT (E.). **Geographie der Chagas-Krankheit.** [The geography of Chagas' disease.]—*Z. Tropenmed. u. Parasit.* **10** pt. 1 pp. 1–5, 1 ref. Stuttgart, 1959. (With a summary in English.)

An attempt is made to correlate the known distribution of Chagas' disease (caused by *Trypanosoma cruzi*) in man in Central and South America with the very incomplete data in the literature on the distribution of the Triatomines that transmit it, which are *Triatoma infestans* (Klug), *T. dimidiata* (Latr.), *Panstrongylus megistus* (Burm.) and *Rhodnius prolixus* Stål. Clinical examinations have shown the disease to be more widespread than was hitherto assumed.

LUMBRERAS (H.), FLORES (W.) & ESCALLÓN (A.). **Allergische Reaktionen auf Stiche von Reduviiden und ihre Bedeutung bei der Chagaskrankheit.** [Allergic reactions to the bites of Reduviids and their significance in Chagas' disease.]—*Z. Tropenmed. u. Parasit.* **10** pt. 1 pp. 6–19, 4 figs., 50 refs. Stuttgart, 1959. (With summaries in English & Spanish.)

Experiments with *Rhodnius prolixus* Stål are recorded showing that a bilateral or unilateral palpedral oedema considered an early recognisable symptom of Chagas' disease (due to *Trypanosoma cruzi*) is caused by the bites of the bug, even uninfected examples causing it to appear in sensitised persons. The reaction is thus of an allergic nature, and it has been induced by the bites of *Panstrongylus megistus* (Burm.) and *Triatoma infestans* (Klug) in persons sensitised by *R. prolixus* or *T. infestans*.

RONNEFELDT (F.). *Anopheles sundaicus* **(Rodenwaldt 1926) als Malariaüberträger in Mittel-Java.** [*A. sundaicus* as a malaria vector in Middle Java.]—*Z. Tropenmed. u. Parasit.* **10** pt. 1 pp. 38–47, 1 graph, 6 refs. Stuttgart, 1959. (With a summary in English.)

The author discusses methods that have been proposed for the evaluation of the density and average expectation of life of Anopheline vectors of malaria and gives results of evaluations for each month in 1957 of the man-hour density, average night catch in houses and density per inhabitant for *Anopheles sundaicus* (Rdnw.) and the parasite indices in man in three localities in Middle Java in which the breeding places were typical for the species but differed from one another. The results and the local conditions are discussed in relation to transmission.

Garms (R.), Weyer (F.) & Rehm (W. F.). **Jahreszeitliche Schwankungen der Empfindlichkeit gegen DDT bei Freilandpopulationen von** *Anopheles atroparvus* **und** *A. messeae* **in Norddeutschland.** [Seasonal variations in susceptibility to DDT in field populations of *A. labranchiae atroparvus* and *A. maculipennis messeae* in northern Germany.]—*Z. Tropenmed. u. Parasit.* **10** pt. 1 pp. 48–55, 11 refs. Stuttgart, 1959. (With a summary in English.)

The following is virtually the authors' summary of this account of investigations in north-western Germany in 1957–58, carried out by ascertaining the LC50's for females by the method of Busvine & Nash [*R.A.E.*, B **41** 156]. The susceptibility of field populations of *Anopheles labranchiae atroparvus* van Thiel and *A. maculipennis messeae* Flni. to DDT showed seasonal changes. While susceptibility of the summer generations remained nearly the same (LC50 1·8–1·9 per cent.), tolerance increased significantly at the beginning of hibernation, in October (LC50 2·5 per cent.). During the winter, tolerance was lower again (LC50 1·5 per cent.), reaching a minimum at the end of hibernation. On the other hand, a rise of tolerance was noted if mosquitos had a blood-meal after hibernation. Such an increase of tolerance may be due to formation of fat-body in the mosquitos, tolerance being reduced by consumption of the lipoid substances.

The mosquitos caught in summer were tested separately according to their physiological state. Fasting individuals proved to be the most susceptible (LC50 1·3 per cent.), while tolerance to DDT was increased after a blood-meal or before oviposition.

Laboratory strains of *A. labranchiae atroparvus* and *A. stephensi* List. were subjected to similar tests. Changes in tolerance of examples of these mosquitos of various ages and physiological states to DDT agreed with the data from field populations, but the latter were in all cases more susceptible than mosquitos reared under laboratory conditions.

Rehm (W. F.) & Garms (R.). **Zur Wirkung von Alodan auf Stechmücken.** [The effect of Alodan on mosquitos.]—*Z. Tropenmed. u. Parasit.* **10** pt. 2 pp. 154–159, 1 graph, 7 refs. Stuttgart, 1959. (With a summary in English.)

Details are given of tests in which Alodan (5,6-di(chloromethyl)-1,2,3,4,7,7-hexachlorobicyclo[2.2.1]heptene-2) [*R.A.E.*, B **48** 47] was compared with DDT and to a less extent with dieldrin for toxicity to larvae and adults of *Anopheles labranchiac atroparvus* van Thiel and *A. stephensi* List. and adults of *Culex pipiens* L. The results showed that Alodan was less toxic than DDT, and dieldrin more toxic than either. In some cases, treatment of the larvae caused death in the pupal or adult stage.

Kuhlow (F.). **On the behaviour of** *Anopheles funestus* **in unsprayed and DDT sprayed houses.**—*Z. Tropenmed. u. Parasit.* **10** pt. 3 pp. 328–333, 7 refs. Stuttgart, 1959. (With a summary in German.)

The following is substantially the author's summary. In Northern Nigeria, two inhabited huts were provided with window traps. One of the huts was sprayed with wettable DDT, and observations were carried out for 12 months on the numbers of *Anopheles funestus* Giles that entered the huts, on the proportion that died inside, on those that remained alive inside, and on those that were caught in the traps. A repellent effect of the DDT deposit was observed. Only 33 per cent. of the number of mosquitos that entered the unsprayed hut entered the sprayed one, and more left the sprayed hut than the unsprayed one. The nutritional condition of the mosquitos caught indicated a remarkable change in the mosquitos forming the population in the huts during each night. Chemical estimations of the insecticide residue showed a loss of 81 per cent. of the original deposit of 5·4 g. p,p′DDT per sq. metre after six months.

METCALF (R. L.). Ed. **Advances in pest control research. Volume IV.**—$9\frac{1}{4} \times 6$ in., vii + 347 pp., 26 figs., many refs. New York, N.Y. & London. Interscience Publishers, Inc., 1961. Price £4 14*s*.

The articles in this fourth volume of a series [*cf. R.A.E.*, B **48** 118, etc.] include: **Synthetic pyrethroids,** by W. F. BARTHEL (pp. 33–74, 143 refs.), which is a review of the chemistry, toxicology and effectiveness against insects of synthetic insecticides related to the pyrethrins, notably allethrin and its analogues (which include furethrin and cyclethrin), barthrin (6-chloropiperonyl chrysanthemate), and the 2,4- and 3,4-dimethylbenzyl chrysanthemates; **Selective toxicity of insecticides,** by R. D. O'BRIEN (pp. 75–116. 3 figs., 97 refs.), in which the author discusses the factors responsible for the differences in toxicity of selective insecticides, chiefly organophosphorus compounds, to the insects that they are designed to kill and other organisms, chiefly man and domestic animals; and **Chemical control of insect pests of domestic animals,** by W. M. ROGOFF (pp. 153–181, 212 refs.), in which mites and ticks are considered, as well as insects, and a table is given showing the pests against which various insecticides are in use, with supporting references to the literature. In addition to a subject index to the volume, there is a cumulative index to the articles in the four volumes so far published.

Symposium on metabolism of insecticides.—*Canad. J. Biochem. Physiol.* **37** pp. [1 +] 1091–1151, 5 figs., many refs. Ottawa, 1959.

The papers read at this symposium, which is noticed in full elsewhere [*R.A.E.*, A **49** 345], include: **Insecticide resistance as a world problem,** by A. W. A. BROWN (pp. 1091–1097, 85 refs.), which is a review of the literature, largely as regards mosquitos and other insects of medical importance; **Control of animal parasites with systemic insecticides,** by D. G. PETERSON & A. A. KINGSCOTE (pp. 1105–1112, 1 fig., 65 refs.), which is a survey of the use of systemic insecticides against pests of livestock and their metabolism in the animal; and **Physiological events in organophosphorus poisoning,** by E. H. COLHOUN (pp. 1127–1134, 1 graph, 26 refs.), which is a review of work, mostly by the author and not all published, on the effects of poisoning by organophosphorus compounds on *Periplaneta americana* (L.), with special reference to the increase in acetylcholine that results and the reactivation of inhibited cholinesterase by pyridine 2-aldoxime methiodide (PAM).

Buéi (V. K.). **The life-history of the sheep blowfly,** *Lucilia cuprina* **Wiedemann.** [In Japanese.]—*Botyu-Kagaku* **24** pt. 3 pp. 115–118, 1 graph, 6 refs. Kyoto, 1959. (With a summary in English.)

When *Lucilia cuprina* (Wied.) was reared in Japan with horse meat as the food for the larvae and horse meat, milk and 2 per cent. sugar solution for the adults, the combined egg and larval stages and the pupal stage lasted about 26·3 and 12·5 days, respectively, at 20°C. [58°F.] and about 7·2 and 6·2 days at 30°C. [86°F.]. The emergence percentages at these two temperatures were 91·5 and 45·4, and the pre-oviposition periods were 6·8 and 3·6 days. The number of eggs laid and the percentage that hatched were greatest at 25°C. [77°F.].

Burns (E. C.) & Nipper (W. A.). **House fly control in pig parlors.**—*J. econ. Ent.* **53** no. 4 pp. 539–540, 1 graph, 9 refs. Menasha, Wis., 1960.

Experiments were carried out in Louisiana in 1958 on the effectiveness of 16-ply cotton cord soaked in 12 per cent. fenchlorphos (ronnel), or 25 per cent. diazinon or Bayer 29493 (O,O-dimethyl O-3-methyl-4-methylthiophenyl phosphorothioate) from emulsion concentrates and installed in pig parlours (series of covered pens with open runways) for the control of *Musca domestica* L. [*cf. R.A.E.*, B **48** 201, etc.]. Strips of treated cord, 18 in. long, were suspended from horizontal cord hung from the ceiling or rafters of the pens at the rate of 28·5 ft. vertical cord per 100 sq. ft. of floor area. Grill counts [**38** 158] of the fly populations showed that satisfactory control of *M. domestica* was obtained within 1–2 weeks and was still being maintained in the pens 10 weeks after the installation of cords impregnated with any of the insecticides tested.

Knapp (F. W.), Terhaar (C. J.) & Roan (C. C.). **Systemic insecticides for cattle grub control.**—*J. econ. Ent.* **53** no. 4 pp. 541–546, 16 refs. Menasha, Wis., 1960.

Tests were carried out in 1957–58 on the effectiveness of fenchlorphos (ronnel), coumaphos (Co-Ral), Dowco 109 (O-methyl O-4-tert.-butyl-2-chlorophenyl methylphosphoramidothioate) and dimethoate for the systemic control of larvae of *Hypoderma* spp. in cattle in Kansas, and the following is mainly based on the authors' abstract of the results. Treatment of cattle from the southern United States in November with 0·5 per cent. sprays of coumaphos, or with dimethoate administered in the food at the rate of 10 mg. per kg. body weight, greatly reduced the numbers of larvae encysted in the backs of cattle, but failed to rid the animal of those migrating to the backs. Dowco 109 applied in December as a 0·5 per cent. spray, as a bolus at 16·5 mg. per kg. body weight or in food at 5 mg. per kg. gave, respectively, 61·2, 93·7 and 84·6 per cent. reductions of both encysted and migrating larvae. Treatment of Kansas-bred cattle in September with sprays of coumaphos or Dowco 109 gave no appreciable control of *Hypoderma* larvae, but Dowco 109 as a bolus at 25 mg. per kg. body weight gave 100 per cent. reduction of larvae. When fenchlorphos was administered to cattle as a bolus at the rate of 110 mg. per kg. body weight monthly, from June to November (except in October), a great reduction of larvae resulted from all the treatments except that given in August. No apparent control of *Hypoderma* larvae was obtained when cattle were fed with fenchlorphos at 2 mg. per kg. body weight daily for 79 days. No toxic symptoms were noted in any of the cattle treated.

Tracy (R. L.), Woodcock (J. G.) & Chodroff (S.). **Toxicological aspects of 2,2-dichlorovinyl dimethyl phosphate (DDVP) in cows, horses, and white rats.**—*J. econ. Ent.* **53** no. 4 pp. 593–601, 2 graphs, 37 refs. Menasha, Wis., 1960.

The following is based on the authors' summary of an investigation of the toxicity of insecticidal concentrations of dichlorvos (DDVP) for mammals. Five horses were exposed continuously to the vapours of 0·5 mg. dichlorvos per cu. ft. in a closed barn for 22 days, and a mild depression in the cholinesterase level of erythrocytes, observed after seven days, was followed by recovery to normal cholinesterase concentrations in 11–22 days. The cholinesterase level of the plasma of horses was within normal limits throughout the test period. The concentration of dichlorvos in the air of the closed barn varied between 0·24 and 1·48 μg. per litre, or 1·4–8·4 per cent. of the daily dose of dichlorvos. Two cows suckling calves showed normal levels of cholinesterase in the erythrocytes while ingesting 200 parts dichlorvos per million in their daily grain ration, but severe depression of cholinesterase occurred when they were given 500 p.p.m. dichlorvos in gelatin capsules twice daily, and a single dose of dichlorvos at 27 mg. per kg. body weight caused collapse with cholinergic symptoms, with recovery in 3 hours. The cholinesterase levels in the calves remained normal for the 78 days of the test. Dichlorvos was administered repeatedly by stomach tube to female rats nursing litters at the rate of 30 mg. per kg. body weight, and the litters of these rats exhibited normal cholinesterase levels in the erythrocytes and plasma, as well as normal weight-growth curves. Fresh liver macerates from various animals, including cattle, pigs and poultry, detoxified dichlorvos, according to bioassay tests with *Musca domestica* L., at a rate of about 500 mg. dichlorvos per g. liver.

Drummond (R. O.), Jackson (J. B.), Gless (E. E.) & Moore (B.). **Systemic insecticides for the control of** *Gasterophilus* **bots in horses.**—*Agric. Chem.* **14** no. 12 pp. 41–43, 100, 12 refs. Baltimore, Md., 1959.

Jackson (J. B.), Drummond (R. O.), Buck (W. B.) & Hunt (L. M.). **Toxicity of organic phosphorus insecticides to horses.**—*J. econ. Ent.* **53** no. 4 pp. 602–604, 8 refs. Menasha, Wis., 1960.

An account is given in the first paper of tests carried out in 1959 on the effectiveness of coumaphos (Co-Ral), dimethoate, Dowco 105 (O-methyl O-4-tert.-butyl-2-chlorophenyl ethylphosphoramidothioate), fenchlorphos (ronnel), Dowco 109 [O-methyl O-4-tert.-butyl-2-chlorophenyl methylphosphoramidothioate], Ruelene (O-methyl O-4-tert.-butyl-2-chlorophenyl methylphosphoramidate), trichlorphon (Dipterex) and dichlorvos (DDVP) for the systemic control of larvae of *Gasterophilus* in horses in Texas. The insecticides were administered by stomach tube, in the feed, or by intramuscular injection. The dung of the horses was examined for larvae of *Gasterophilus* one day before and daily for one week after treatment, after which the horses were slaughtered and their gastro-intestinal tracts examined for the presence of larvae. All larvae found were *G. nasalis* (L.) or *G. intestinalis* (Deg.) [*cf. R.A.E.*, B **39** 185]. No larvae were expelled when the horses were treated with coumaphos, Dowco 105, fenchlorphos or dimethoate, administered by stomach tube, but Ruelene and Dowco 109 were effective at 100 mg. per kg. body weight, dichlorvos at 50 mg. and trichlorphon at 75 and 100 mg. When added to the feed, dichlorvos gave effective control at 25 and 50 mg. per kg. body weight, and trichlorphon at 25–75 mg. Trichlorphon at 25 mg. was fairly effective when injected intramuscularly. Most of the larvae expelled during the first three days were alive, but very few pupated. Almost all the treated horses showed depression of blood-cholinesterase activity, but the only ones to show signs of poisoning were six of the 24 treated by stomach tube. These had received coumaphos at 25 mg., trichlorphon at 100 mg., dichlorvos at 25 and 50 mg. and Ruelene at 50 and 100 mg.; the animal poisoned by coumaphos was the most severely affected.

Observations on the toxicity to the horses of the eight organophosphorus compounds, as used in the tests, are presented in greater detail in the second paper.

Snow (W. E.), Pickard (E.) & Hawkins (J. L.). **Observations on the biology of** *Psorophora cyanescens*.—*J. econ. Ent.* **53** no. 4 pp. 619–621, 5 refs. Menasha, Wis., 1960.

Observations were made for several years on the bionomics of *Psorophora cyanescens* (Coq.) in the Tennessee Valley. The adults were present from 25th April to 15th October, occurring in greatest numbers in July–September. The females are persistent, vicious biters and feed at any time of day or night, but are most active at dusk. At night, adults dispersed readily to lighted areas. Catches indicated that the females prefer to feed in open situations near the ground, but that in forests they tend to feed at higher elevations in the canopy. Larvae were collected mainly in open grassy depressions and ditches that were flooded temporarily or intermittently [*cf. R.A.E.*, B **27** 257]. One of a series of depressions, in which *P. cyanescens* was found breeding, was flooded artificially at intervals. Before flooding, samples were taken of the soil in this experimental basin, and the number of mosquito eggs present was estimated to determine the potential productivity of the basin. Overwintering eggs did not hatch when it was flooded on 2nd–4th April 1957 with river water at 59°F., the soil temperature being below 76°F., but hatched after a subsequent flooding on 29th–30th April when the temperature of the soil reached 89°F., and that of the river water 70°F. Eggs of *Aëdes vexans* (Mg.) hatched in both floodings. Eggs less than one month old, laid by females of *P. cyanescens* in the laboratory, hatched in water, the oxygen content of which had been decreased, but did not do so in strained pond water or tap water alone.

Hecht (O.), Mancera (O.) & Barrera (A.). **Relation of DDT-irritation threshold to knockdown of three species of Anopheline mosquitoes.**—*J. econ. Ent.* **53** no. 4 pp. 634–640, 5 figs., 5 refs. Menasha, Wis., 1960.

Experiments were carried out to compare the irritability on contact with DDT of females from laboratory colonies of *Anopheles albimanus* Wied., *A. aztecus* Hffm. and *A. quadrimaculatus* Say with their physiological condition and their susceptibility to the insecticide. The following is substantially the authors' summary of the results. The threshold of irritation and period of exposure needed for complete knockdown were determined for unfed and blood-fed females of each species by means of a special apparatus, in which each mosquito that flew away from a surface treated with DDT was trapped in a container and there kept in almost continuous contact with the insecticide until knockdown occurred. When the exposure times taken to provoke the response (the thresholds of irritation) were compared with those required for knockdown, no relation was found between the data for individual females, but the collective results showed that the most irritable species, *A. albimanus*, was also the most susceptible to knockdown. Comparison of the thresholds of irritation of unfed and fed females of *A. aztecus* showed almost no decrease in irritability due to feeding, whereas the fed females of both *A. albimanus* and *A. quadrimaculatus* were about half as irritable as the unfed.

Olive (A. T.). **Infestation of the imported fire ant,** *Solenopsis saevissima* **v.** *richteri*, **at Fort Benning, Georgia.**—*J. econ. Ent.* **53** no. 4 pp. 646–648. Menasha, Wis., 1960.

A few mounds of *Solenopsis saevissima richteri* Forel were found at Fort Benning, Georgia, in late September 1956 and the ant appeared in large numbers with the advent of warm weather in 1957, and about 300 people received treatment for stings by it. In July 1957, granules containing 5 per cent. heptachlor were applied to infested areas at the rate of 40 lb. per acre, and individual mounds were broken open and treated with a handful of the granules. Excellent control was obtained and the number of injuries due to the insect dropped to a low level. Up to the winter of 1957 no reinfestation had occurred. The pattern of invasion and dispersion of *S. s. richteri* indicated that cars played an important part in the spread of the ant.

Mulla (M. S.). **Loss of chlorinated hydrocarbon insecticides from soil surface in the field.**—*J. econ. Ent.* **53** no. 4 pp. 650–655, 3 graphs, 6 refs. Menasha, Wis., 1960.

As chlorinated hydrocarbons have been used successfully as soil treatments for the control of *Hippelates collusor* (Tns.) [*R.A.E.*, B **49** 117], experiments were conducted in California to determine the loss of activity of DDT, endrin, SD-4402 (1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan) and aldrin from the surface of the soil in the field. Sprays of the insecticides were applied to sand in boxes at the rate of 100 U.S. gal. per 6-in. acre [*loc. cit.*], and the boxes were placed in the ground with their tops flush with the surface of the soil in an open vineyard exposed to sunlight throughout the day. Samples of the treated sand were removed at intervals, and the rate of loss of activity was determined by adding eggs of *H. collusor* to mixtures of the treated sand and organic matter and counting the number of emerging adults [*cf. loc. cit.*], or by exposing fourth-instar larvae of *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) to acetone-extracts of the treated sand in water and observing their mortality after 24 hours. After exposure for 24 hours, the percentage decreases in activity against *Hippelates* and (in brackets) *Culex* were 5 (13) for DDT, 56 (47) for endrin, 65 (8) for aldrin and 67 (55) for SD-4402. Further decreases occurred with passage of time up to 92–144 hours in most cases; DDT was the most persistent of the insecticides. The loss of activity of DDT over the entire exposure period shown by the tests with *Culex* larvae was less than that shown by the tests with *Hippelates*.

Chamberlain (W. F.), Gatterdam (P. E.) & Hopkins (D. E.). **Metabolism of P^{32}-Delnav in cattle.**—*J. econ. Ent.* **53** no. 4 pp. 672–675, 10 refs. Menasha, Wis., 1960.

Delnav [2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)] has been used successfully for the control of *Dermacentor albipictus* (Pack.) and *Siphona irritans* (L.) on cattle [*R.A.E.*, B **49** 33, 34], and studies were made of the absorption, excretion and metabolic fate of the radioactive toxicant in cattle. Delnav, labelled with ^{32}P, was applied to two steers; one was sprayed with an emulsion at a rate of 16·2 mg. toxicant per kg. body weight, and the other was given the insecticide in capsule form at a rate of 4·65 mg. per kg. The following is mainly based on the authors' abstract. Analyses of blood, urine and faeces of the steers indicated that the insecticide was rapidly metabolised and excreted. Seven days after treatment, both animals showed only traces of radioactivity in the urine and faeces, but the total figure of 20·4 per cent. of the sprayed dose that was found in the urine indicated efficient absorption of Delnav, as compared with other organophosphorus insecticides [*cf.* **48** 119, 175]. The presence of three major hydrolysis products, diethyl phosphoric, diethyl phosphorothioic and diethyl phosphorodithioic acids, in the urine of both animals, indicated a split in the Delnav molecule at the bond between phosphorus and sulphur in the P-S-C linkage, as well as at that between sulphur and carbon, with oxidation before or after hydrolysis [*cf.* A **48** 215].

DRUMMOND (R. O.) & MOORE (B.). **Systemic insecticides as feed additives for cattle grub control.**—*J. econ. Ent.* **53** no. 4 pp. 682–683, 5 refs. Menasha, Wis., 1960.

Tests were carried out in Texas on the effectiveness of fenchlorphos (ronnel), dimethoate, coumaphos (Co-Ral), Dowco 105 (O-methyl O-4-tert.-butyl-2-chlorophenyl ethylphosphoramidothioate), trichlorphon (Dipterex) and Dowco 109 (O-methyl O-4-tert.-butyl-2-chlorophenyl methylphosphoramidothioate) in repeated small dosages as feed additives for the systemic control of larvae of *Hypoderma* spp. in cattle. In July 1957, two steers were given 25 per cent. wettable fenchlorphos daily at 1 and 3 mg. toxicant per kg. body weight, for 42 and 70 days, respectively, and in monthly examinations, from August to January, 24 larvae were found encysted in the former animal, and one in the latter. In late July and early August 1958, a 10 per cent. dimethoate concentrate was added to the feed of two groups, each of four cattle, at rates of 15 and 7·5 mg. toxicant per kg. body weight, for 1 and 2 days, respectively, and gave 81 and 91 per cent. control of *Hypoderma* larvae. Coumaphos, added to the feed of four similar groups of cattle at 20, 10, 4 and 4 mg. per kg. body weight, for 1, 2, 5 and 10 days, respectively, gave 50, 0, 26 and 40 per cent. control. Complete control resulted when, in December, two groups of cattle from Wyoming, each containing four beasts, were given feed containing Dowco 105 at 15 mg. per kg. for 10 days, or Dowco 109 at 20 mg. per kg. for 5 days; in three similar groups, 99 per cent. control resulted from dimethoate at 5 mg. per day for 5 days, or from trichlorphon at twice this rate for twice the time, and 91 per cent. from coumaphos at 10 mg. for 5 days. No ill effects were observed in any of the animals treated in these tests, but some depression of blood cholinesterase was noticed.

BRENNAN (J. M.) & MAKI (W. A.). **An inexpensive and effective indoor insectary.**—*J. econ. Ent.* **53** no. 4 pp. 685–688, 4 figs. Menasha, Wis., 1960.

A description is given of an insectary consisting of units, each large enough to walk into and each with independently controlled temperature, humidity, illumination and air circulation, in which *Culex tarsalis* Coq. was reared successfully for two years.

Flynn (A. D.) & Eden (W. G.). **Systemic and topical insecticidal activity of some substituted phosphates and phosphorothioates.**—*J. econ. Ent.* **53** no. 4 pp. 692–693, 4 refs. Menasha, Wis., 1960.

An account is given of experiments in which 18 substituted phosphates and phosphorothioates were evaluated for systemic activity against ectoparasites when administered orally to rabbits. The test arthropods were bed-bugs (*Cimex lectularius* L.), ticks (*Amblyomma maculatum* Koch), stable flies (*Stomoxys calcitrans* (L.)) and *Aëdes aegypti* (L.). The LD50's of 16 of the compounds for unengorged bed-bugs and of 15 for stable flies were determined by topical application to the abdomens. The most toxic material for the rabbits was O-methyl O-ethyl O-2,4,5-trichlorophenyl phosphorothioate with a maximum sublethal dose of 50 mg. per kg. It was followed by O,O,O-trimethyl phosphorothioate (75 mg. per kg.). The substituted phenyl phosphates were more toxic than the corresponding phosphorothioates, and O,O-dimethyl O-phenyl phosphorothioate was the least toxic of all the compounds tested, with a maximum sublethal dose of more than 600 mg. per kg. The addition of chlorine to the phenyl ring increased toxicity, and two chlorine atoms increased it more than one, and three more than two. In the 2,4,5-trichlorophenyl phosphorothioates, replacement of the methyl groups with an amido group lowered toxicity to the rabbit, but replacement of one methyl with ethyl greatly increased it.

Only compounds containing dimethyl or a methyl and an ethyl group with two or three chlorine atoms on the phenyl ring showed systemic activity against *C. lectularius*. Among the dimethyl compounds, dimethyl 2,4,5-trichlorophenyl phosphate and fenchlorphos (O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate) caused 100 per cent. mortality of the bugs, but dimethyl 2,4,6-trichlorophenyl phosphate caused none, indicating the significance of the position of one chlorine atom in the trichloro-substituted compounds. O-Methyl O-ethyl O-2,4,5-trichlorophenyl phosphorothioate also gave complete control, though the dosage given to the rabbit was less. In the dimethyl compounds with two chlorine atoms, only dimethyl 2,4-dichlorophenyl phosphate showed systemic toxicity to *C. lectularius*, causing 94 per cent. mortality. The fact that dimethyl 2,5-dichlorophenyl phosphate caused no mortality showed the significance of position of the chlorine atom, and the failure of O,O-dimethyl O-2,4-dichlorophenyl phosphorothioate and O,O-diethyl O-2,4-dichlorophenyl phosphorothioate indicated differences between the phosphates and phosphorothioates. Only dimethyl 2,4-dichlorophenyl phosphate, O,O-dimethyl O-2,4-dichlorophenyl phosphorothioate and O-methyl O-ethyl O-2,4,5-trichlorophenyl phosphorothioate showed any considerable activity against the tick, giving 92, 76 and 73 per cent. mortality, respectively. The only compounds with high systemic activity against *A. aegypti* were dimethyl 2,4-dichlorophenyl phosphate, which gave complete control, and O-methyl O-2,4,5-trichlorophenyl phosphoramidothioate and trimethyl phosphate which caused 64 and 80 per cent. mortality, respectively. Eight analogues gave complete mortality of *S. calcitrans*. These were dimethyl 2-chlorophenyl phosphate, O,O-dimethyl O-2-chlorophenyl phosphorothioate, dimethyl 2,4-dichlorophenyl phosphate, O,O-dimethyl O-2,4-chlorophenyl phosphorothioate, dimethyl 2,5-dichlorophenyl phosphate, dimethyl 2,4,5-trichlorophenyl phosphate, O,O-dimethyl O-2,4,5-trichlorophenyl phosphorothioate and O-methyl O-2,4,5-trichlorophenyl phosphoramidothioate. Dimethyl 4-chlorophenyl phosphate caused 93 per cent. mortality, but O,O-dimethyl O-4-chlorophenyl phosphorothioate caused little, as did dimethyl 2,4,6-trichlorophenyl phosphate and O,O-diethyl O-2,4-dichlorophenyl phosphorothioate. Thus, only dimethyl 2,4-dichlorophenyl phosphate was highly systemic against the four species tested. It is concluded that the study indicated dimethyl phenyl phosphates with di- or trichlorine ring substitutions in the 2,4- or 2,4-5-positions to be the most active systemic compounds. Those that were most active systemically against *C. lectularius* and *S. calcitrans* were also the most toxic to them when applied topically.

LaBrecque (G. C.) & Smith (C. N.). **Tests with young poultry for the control of house fly larvae under caged laying hens.**—*J. econ. Ent.* **53** no. 4 p. 696, 1 ref. Menasha, Wis., 1960.

As it has been shown that *Musca domestica* L. in poultry houses in California could be controlled by giving young cockerels access to the droppings in which the house-fly larvae were developing [*R.A.E.*, B **48** 170], a similar technique was tested in Florida. Chicks, two weeks old, were confined under the cages of laying hens at a rate of one per ten hens; in one test, they were allowed access to the whole of the floor area, and in the second, they were confined to that part of the floor immediately beneath the cages. Initial counts showed that the numbers of larvae present in the manure averaged 350 at the beginning of the first test and over 1,000 at the beginning of the second. All larvae were eliminated one week after the chicks were introduced, and complete control was maintained for as long as the tests were continued. In two supplementary tests, chicks, one month old, were confined to the area directly beneath caged laying hens, and, within five days, 100 per cent. control of house-fly larvae was achieved and maintained for two months, when the tests were ended because, with the onset of winter, no larvae were found in an untreated area.

Shemanchuk (J. A.). **Mosquitoes (Diptera: Culicidae) in irrigated areas of southern Alberta and their seasonal changes in abundance and distribution.**—*Canad. J. Zool.* **37** (1959) no. 6 pp. 899–912, 10 figs., 13 refs. Ottawa [1960].

A study of the seasonal changes in abundance and distribution of economically important mosquitos was made in southern Alberta. An area of 16 sq. miles in an intensively irrigated region was compared with one of the same size in unirrigated grazing land in 1956, and areas of 6 sq. miles were studied in 1957 in three irrigation districts representing distinct farming practices. The species found, nearly all as both adults and larvae, comprised 16 Culicids (*Anopheles earlei* Vargas, *Culex tarsalis* Coq., *Culiseta inornata* (Will.), *C. alaskaensis* (Ludl.) and 12 species of *Aëdes*) and two Chaoborids. Brief notes are given on the habits of most of them. Populations of larvae and pupae were calculated as weekly indices (the product of the average number per dip, in 20 dips with a quart dipper, and the water surface of the breeding place in square yards); the weekly number for each area was the sum of the indices. Adults were collected in visual-attraction traps [see next abstract] at the irrigated sites. There was very little mosquito production in the non-irrigated area; a little in May was attributed to spring run-off rather than to rain, and a little followed 2·19 in. of rain in August. Irrigation begins early in June, and populations of larvae and pupae in irrigated areas generally reached a peak shortly after this and again after subsequent applications of water. Adult populations were highest in July and August. Adults, and more particularly males, were more numerous in a sheltered than in an open site. Mosquitos were more abundant in the older than in the newer irrigated districts, and improper methods of farming and water-management favoured increases in numbers, even in districts in which irrigation was well planned.

HAUFE (W. O.) & BURGESS (L.). **Design and efficiency of mosquito traps based on visual response to patterns.**—*Canad. Ent.* **92** no. 2 pp. 124–140, 5 figs., 31 refs. Ottawa, 1960.

An account is given of the development of a mosquito trap in which the principle of attraction is response to moving patterns. A black and white spirally striped cylinder rotates on bearings around a central shaft extending upwards from a framework containing a high velocity fan. Mosquitos approaching the cylinder are attracted towards the black and white contour lines [*cf. R.A.E.*, B **28** 167; **38** 121], inward spiralling of the pattern directs them towards the opening at the top of the cylinder and a spirally striped horizontal disk extending above the cylinder directs them into the descending airstream and to a killing jar. During periods of low natural light intensity the trap is illuminated with artificial white light. A mechanical device [*cf.* **38** 124] in the visual-attraction trap divided the samples at short regular intervals.

Field tests in subarctic Manitoba in 1951 indicated that traps depending on attraction to patterns caught large numbers of mosquitos (*Aëdes* spp.) in situations in which ordinary light-traps were unsatisfactory and allowed sampling of mosquitos by day as well as at night. As the black and white pattern gave better contrast than competing patterns in the environment, attraction was exercised over the whole 24 hours. Special tests on illumination for night operation showed that a relatively uniform contrast in the pattern could be maintained over 24-hour periods with artificial white light, and results were similar with blue light. Illumination in the yellow–red end of the spectrum reduced attraction to the pattern.

The volume of air space sampled was proportional to the width of the stripes, as attraction depends on a minimum ommatidial angle subtended by an individual stripe. It remains constant under different light conditions and can be restricted, if necessary, to allow studies on the flight of mosquitos in relation to microclimate. In the trap used, there were 12 stripes $1\frac{5}{8}$ in. wide, and the stripe displacement rate was 160–180 per minute. Mosquitos were attracted from a distance of 32 in. The volume of air space from which mosquitos are attracted to light cannot be defined.

KRIEG (N. R.), WEDBERG (S. E.) & PENNER (L. R.). **The cockroaches** *Blaberus craniifer* **and** *Blaberus discoidalis* **as vectors of** *Salmonella typhosa*.—*Amer. J. trop. Med. Hyg.* **8** no. 2 (pt. 1) pp. 119–123, 3 figs., 10 refs. Baltimore, Md., 1959.

As attempts to infect cockroaches with *Salmonella typhi* (*typhosa*) have failed [*cf. R.A.E.*, B **11** 39; **42** 31], experiments were carried out to determine the agent responsible for the destruction of the bacteria in the insects. Adult females of *Blaberus craniifer* Burm. and *B. discoidalis* Serv. were fastened to wooden blocks and their excreta were collected in sterile petri dishes containing media suitable for the growth of bacteria. The mounted insects were fed on skimmed milk, yeast extract and sucrose, and, in the infective feeding tests, with a milk suspension of *S. typhi* or *S. enteritidis*. *S. enteritidis* was excreted up to 17 days after being ingested by the cockroaches, but *S. typhi* was recovered only once, within 24 hours after the meal. In tests of bactericidal action *in vitro*, the crop, midgut and hindgut of cockroaches were placed separately on agar seeded with *S. typhi* or *S. enteritidis*, and an antibacterial agent was shown to be present in the crop that had a marked effect on the first, but little or none on the second. The pH values in the crops of cockroaches, determined with a microquinhydrone electrode, ranged from 3·9–4·9, the most common being 4·5. *S. typhi* was destroyed *in vitro* at pH values below 4·7, but *S. enteritidis* was more resistant to acidity. When cockroaches were fed with milk containing powdered carmine, the crops were still red after 12 hours, so that *Salmonella* suspensions in milk would probably remain for similar periods in the crop. Organisms resembling *Propionibacterium freudenreichii*, isolated from crops and smeared on agar seeded with *S. typhi*, produced zones in which the *Salmonella* was inhibited, and the effects appeared to be due to the acid produced by the isolates. The antibacterial effect *in vivo* against *S. typhi* is thus probably due to prolonged exposure to the acid produced in the crop through the action of micro-organisms. Attempts to demonstrate bacteriophage activity that might account for the destruction of typhoid organisms in cockroaches were unsuccessful.

BEADLE (L. D.). **Field observations on the biting habits of** *Culex tarsalis* **at Mitchell, Nebraska, and Logan, Utah.**—*Amer. J. trop. Med. Hyg.* **8** no. 2 (pt. 1) pp. 134–140, 3 figs., 16 refs. Baltimore, Md., 1959.

Culex tarsalis Coq. is an important vector of the western equine and the St. Louis encephalitis, and systematic studies were made over a whole mosquito season on its biting habits in urban and rural sites at Mitchell, Nebraska, in June–October 1953, and at Logan, Utah, in June–September 1954. Routine collections of mosquitos were made with a New Jersey light-trap, operated nightly at each site from sunset to sunrise, and from the bare legs of an operator during the two hours after sunset. Incidental collections were made by hand from a tethered cow and horse and by traps baited with a sheep and calf or with fowls. The following is based on the author's summary and conclusions. *C. tarsalis* was the most abundant species taken on the operator at the rural site at Mitchell and at the urban site at Logan, forming about half the catches, but it ranked second to *Aëdes vexans* (Mg.) at the urban site in Mitchell and the rural one at Logan, in which it constituted about a quarter of the mosquitos caught. At the urban site at Mitchell, where there was an abundance of bird hosts, *C. tarsalis* was not observed to enter the house, but did so at Logan, where birds were not so numerous. The studies showed that *C. tarsalis* feeds readily on a wide range of hosts, including wild birds and fowls [*cf. R.A.E.*, B **47** 96], cattle, sheep and man, from June until early September, when a marked decrease in blood-feeding activity was observed with the advent of cool weather [*cf.* **48** 222–223]. In both areas, the normal peak of biting activity began 30 minutes after sunset and lasted for one hour; large numbers of mosquitos were caught at temperatures of 56–78°F., the largest being in the fourth 15-minute period after sunset, when the mean temperatures of the two places were 68·8 and 63·5°F., respectively.

CHARLES (L. J.). **Observations on** *Anopheles* (*Kertezia*) *bellator* **D. & K. in British Guiana.**—*Amer. J. trop. Med. Hyg.* **8** no. 2 (pt. 1) pp. 160–167, 3 figs., 27 refs. Baltimore, Md., 1959.

In surveys made in 1952–54 and 1958, *Anopheles bellator* D. & K. was found in British Guiana, where it had apparently not been recorded before, among larvae and pupae of mosquitos collected from bromeliads [*cf. R.A.E.*, B **42** 127, etc.] and adults caught on man at dusk. It was found along the upper reaches of all the rivers in the North West District, adjoining a known focus of this species in eastern Venezuela, and in three other areas with high rainfall. In a small community on the Barima River in the North West District, a few children aged 1–10 years were found to have enlarged spleens and *Plasmodium vivax* in their blood in 1958, indicating recent malarial infection. As *A. bellator* was the only Anopheline captured in this area, it is concluded that it is the vector of malaria there.

de Rodaniche (E.), Galindo (P.) & Johnson (C. M.). **Further studies on the experimental transmission of yellow fever by** *Sabethes chloropterus.* —*Amer. J. trop. Med. Hyg.* **8** no. 2 (pt. 1) pp. 190–194, 8 refs. Baltimore, Md., 1959.

Three further investigations by techniques similar to those used previously [*R.A.E.*, B **47** 57] were conducted in Panama on the experimental transmission of yellow fever to monkeys by *Sabethes chloropterus* (Humb.). A strain of virus isolated in Trinidad from the spleen of a howler monkey [*Alouatta*] [*cf.* **45** 101] was used in one, and a strain isolated locally from naturally infected *S. chloropterus* [**47** 158] in the others. Rhesus monkeys (*Macaca mulatta*) were injected subcutaneously with virus 2–4 days before they were exposed to *S. chloropterus*. Older females of *S. chloropterus* were allowed to feed on the infected monkeys, as biting activity in this species is greatest in the second or third week after emergence [**48** 226]. After suitable extrinsic incubation periods, the mosquitos were allowed to feed on normal rhesus monkeys in two experiments and on wild uninfected black spider-monkeys (*Ateles geoffroyi grisescens*) in the third. The Trinidad strain of virus was not transmitted, but two rhesus monkeys became infected when exposed to mosquitos, infected with the local strain, after extrinsic incubation periods of 34–37 and 43–44 days, respectively. One of these monkeys had previously been exposed to mosquitos after an extrinsic incubation period of only 27–30 days, but did not appear to become infected after one week, whereas virus began to circulate in its blood five days after the second exposure. In the third experiment, the local strain of virus was not transmitted to black spider-monkeys, which do not seem to be susceptible to infection. It is concluded that *S. chloropterus* is not an efficient vector.

Daggy (R. H.). **Malaria in oases of eastern Saudi Arabia.**—*Amer. J. trop. Med. Hyg.* **8** no. 2 (pt. 2) pp. 223–291, 24 figs., 65 refs. Baltimore, Md., 1959.

Local conditions contribute to a high endemic potential for malaria in the oases of eastern Saudi Arabia, where the disease has long been of primary importance. Surveys and observations, chiefly in the Qatif and Al Hasa oases [*cf. R.A.E.*, B **33** 202], on the coast of the Persian Gulf, were begun in 1947 with a view to developing plans for control. They form the subject of the present paper, in which the area is described and full accounts are given of the results of the 11 years' work on the disease and its transmission, the success of measures against Anophelines over the period and the prospects for the future. The following account of the findings and conclusions is based largely on the author's summary.

Malaria affects the settled population, which numbers about 310,000. Nomadic Bedouins are not normally involved. The amount of infection in the various villages depends directly on their nearness to irrigated land and its extent. No general direct measurement can be made owing to the lack of vital statistics for the area, but malaria may reach hyperendemic proportions and cause appreciable mortality when uncontrolled. In 1941–47, before control measures were taken, the number of cases reported annually among indigenous employees of the Arabian American Oil Company varied from 1,045 to 2,783 per 10,000, with an average of 1,604. About 11 per cent. of all deaths occurring in the company's hospitals in 1941–47 were caused by malaria. Malaria surveys in typical oasis villages in the Qatif area in 1947 before control was begun showed average parasite and (in brackets) spleen rates of 85 (94) per cent. in children 2–14 years old and 100 (64) per cent. in infants. *Plasmodium falciparum* predominated somewhat over *P. vivax*, and *P. malariae* was also present.

The Anophelines of the area are *Anopheles stephensi* List., *A. fluviatilis* James, *A. pulcherrimus* Theo., *A. sergentii* (Theo.), *A. multicolor* Camb. and *A. coustani* var. *tenebrosus* Dön. *A. stephensi* is the only important vector of malaria [*cf.* **27** 153–154]; *A. fluviatilis* may be of secondary importance, but the part it plays locally is unknown. *A. stephensi* is present in enormous numbers, especially during spring and autumn. It rests in man-made shelters by day and feeds only after sunset. It formed 90·6 per cent. of the Anophelines taken in house collections in 1947–49 and 79·3 per cent. of those taken in light-traps operated about twice a month from October 1948 to July 1950. Its hosts include various warm-blooded animals, and though it feeds avidly on man, limited precipitin tests on females from Bahrein indicated that man is not favoured. Breeding takes place in a wide variety of surface waters, including drainage ditches, seepage areas, ponds, shallow wells, borrow-pits and puddles, but not to any appreciable extent in rice-fields. The water is usually clear and clean, but drains containing polluted water occasionally yielded larvae [*cf.* **20** 31]. Both larvae and adults can be found in all months of the year. Populations are greatest in April and October. Temperatures in winter are low enough to reduce breeding but not to stop it. The very hot summers are the critical period, and populations are lowest from June to September. Microclimates are important in giving protection from extremes at this time.

There is a characteristic seasonal cycle of malaria morbidity, also with highest rates in spring (May) and autumn (November), and lowest ones in summer. This seasonal distribution is controlled largely by temperature variations, with the very high relative humidity of late summer and early autumn playing an important secondary part. Temperature and humidity together affect the total population of *A. stephensi*, the length of life of individual females, infectivity, development of the parasite in the mosquito and the behaviour of the human host. Rainfall is of little or no significance. October, with mean monthly temperatures of 82°F. and mean relative humidity of 65 per cent. or above, is the most favourable season for transmission. Temperature is then optimum for the extrinsic development of the parasite, and higher temperatures earlier in the year (90°F.) have allowed maximum densities of the vector to be built up. In spring, optimum temperatures for the parasite occur in late April and early May, but relative humidity declines from favourable to unfavourable levels before temperatures become optimal for the development of the vector. Vector densities do not therefore reach their full potential in spring, and the malaria season is shorter and morbidity is less than in the autumn. Variations from a standard pattern of morbidity can be predicted from the preceding month's variations from average temperature and relative humidity.

House spraying in autumn with DDT at about 200–250 mg. per sq. ft. was begun in Qatif oasis in 1948, when a kerosene solution was used, and repeated with a wettable-powder suspension in most years from 1949 to 1954. Anopheline control resulted in adequate reduction in malaria transmission until late in 1953, when an increase in malaria morbidity for November from 19–62 to over 310 per 10,000 indigenous employees of the oil company, accompanied by a rise from 0 to 31·3 per cent. in infant parasite rates in two experimental villages that had been treated without interruption, indicated DDT resistance in *A. stephensi.* Malaria rates were unsatisfactory in 1954 and 1955, and the intervals between spraying and the return of *A. stephensi* to DDT-treated shelters fell from 12–14 months in 1948 to two months in 1954. Laboratory investigation of females of *A. stephensi* from an area in which DDT had been first used in 1949 and from an untreated area near Dhahran showed ten-fold resistance to DDT in the former. Dieldrin at 50–70 mg. per sq. ft. replaced DDT as the chief insecticide in 1955 and was applied each autumn in the next three years. It proved to be more effective than DDT had ever been in reducing malaria transmission, which had virtually ceased by the end of 1957. For maximum effectiveness, applications should be completed in September. In view of the possibility of the development of resistance to dieldrin, the potential value of classical control measures such as water-management. draining and filling and the use of larvivorous fish is discussed. Improvements in water-management techniques are thought to give the most promise. The eradication of malaria from the oases is recommended as a practical goal.

Smith (A.) & Draper (C. C.). **Malaria in the Taveta area of Kenya and Tanganyika. Part II. Results after three and a half years' treatment of huts with dieldrin.**—*E. Afr. med. J.* **36** no. 12 pp. 629–643, 3 graphs. 4 refs. Nairobi, 1959.

In a malaria-control experiment in the Taveta area of Kenya and adjoining parts of Tanganyika [*cf. R.A.E.*, B **48** 178, 179–180], the interiors of practically all inhabited huts, their kitchens and latrines were sprayed with a suspension of dieldrin from a water-dispersible powder to give a deposit of about 80 mg. per sq. ft. in the second half of 1955 and again at half the dosage five times at intervals of eight months, the last cycle being completed in December 1958. Densities of *Anopheles gambiae* Giles and members of the group of *A. funestus* Giles in huts were reduced to very low levels immediately after the first spraying. There was a slight increase in *A. gambiae* in January and February 1956 and a greater one in June and July 1957 associated with heavy rain in the preceding months. The reduction of the *funestus* group was maintained for the 3½ years. Typical *A. funestus*, which was the principal malaria vector, was almost eradicated [*cf.* **48** 180]. Extensive larval collections during the third year of spraying showed that nearly all the remaining members of the group were *A. funestus confusus* Evans & Leeson and *A. rivulorum* Leeson, though eight larvae indistinguishable from those of typical *A. funestus* were found. Numbers of mosquitos entering untreated, mostly newly built, huts showed reductions of 63 per cent. in the case of *A. gambiae* and 98 per cent. in that of the *funestus* group. In experiments in paired experimental huts, the numbers of adults of *A. gambiae* entering treated and (in brackets) untreated huts were 9·5 (12·3) per day before spraying and 0·4 (2·1), 1·4 (4·1) and 0·2 (2·3) in the first, second and third years of treatment, respectively. Corresponding figures for members of the *funestus* group were 7·1 (8), 0·2 (0·8), 0·1 (0·4) and 0·004 (0·05), respectively.

Analysis of catches made between December 1954 and August 1955 and during the corresponding months of the next three years showed that the proportion of fed to gravid females of *A. gambiae* increased from 1·5 : 1 before spraying to 8·1 : 1 while it was in progress. There was no indication that more recently fed, gravid or unfed females were leaving huts before they had received a fatal dose. The proportions of recently fed females found inside the huts and alive in the window traps were similar in treated and untreated huts and little different from those observed before spraying, and precipitin tests showed no significant change in the proportions of females of *A. gambiae* feeding on man and cattle. Collections from the 20 box shelters in the forest and five at Mata [**48** 179] showed a great reduction in catches of *A. gambiae* at both sites initially, and this was maintained throughout the period of spraying. Catches of *A. gambiae* in vegetation in Mata per 54 man-hours of searching between June and August were 0, 1 and 0 in the three years of spraying, as compared with 142 before spraying. There was a similar reduction among the *funestus* group. As before, cattle were the chief source of food for females resting outdoors. The average catches of females of *A. gambiae* and (in brackets) of the *funestus* group biting man outdoors between 7 and 9 p.m. in four localities were 0·92 (0·76) per man per night before spraying and 0·21 (0·24), 0·14 (0·2) and 0·13 (0·1) in the next three years. No infected female of *A. gambiae* was found among 2,060 caught in huts in areas that received the full six treatments, but one sporozoite infection was found in March 1958 among 283 females from huts in an area undergoing rapid settlement and in which a large proportion of huts was untreated. No spraying had been done in this area in the first and second cycles. No infection was found among 329 females of the *funestus* group and 60 of *A. pharoensis* Theo. from huts or among 405 of *A. gambiae*, 1,993 of the *funestus* group and 582 of *A. pharoensis* from artificial and natural resting places outdoors.

Spleen and parasite rates in the human population had begun to decrease in all areas six months after the first spraying and continued to fall steadily thereafter. The proportion of *Plasmodium malariae* to *P. falciparum* rose in the first year of spraying, but later fell again. A certain number of infections in infants under two years old who had never left the sprayed zone indicated that a small amount of transmission was still occurring. The explanation of this residual transmission is not known; it is possible that some unidentified secondary vector is involved.

SERVICE (M. W.). **Mosquito survey of some areas in the Southern Cameroons under United Kingdom administration.**—*W. Afr. med. J.* (N.S.) **7** no. 4 pp. 161–169, 23 refs. Ibadan, 1958.

GIBSON (F. D.). **Malaria parasite survey of some areas in the Southern Cameroons under United Kingdom administration.**—*T. c.* pp. 170–178, 1 map, 11 refs.

In the first of these papers, lists are given of the species of mosquitos collected either as adults or larvae or both during a survey of many villages in four divisions of the Southern Cameroons under United Kingdom administration, made at the beginning of the dry season (January–February) in 1957. Notes are included on breeding places and prevalence. The 11 species of *Anopheles* taken included one recently described as *A. buxtoni* Service [*R.A.E.*, B **48** 231], an East African subspecies (*mousinhoi* De Meillon & de Carvalho Pereira) of *A. marshallii* (Theo.) and *A. freetownensis* Evans, which had not previously been recorded from the Cameroons. *A. funestus* Giles was taken in all four divisions and was fairly common in most of them, but *A. gambiae* Giles was not found in two, though it had been recorded from them in an earlier survey. It is concluded that, in these, *A. funestus* is responsible for the transmission of malaria in the dry season. It was breeding in abundance not only in streams but also in rock pools. A list of the 15 Anophelines and 46 species of Culicines known to occur in the British Cameroons as a result of this survey or previously published records is appended.

In the second paper, an account is given of the prevalence of malaria in the Southern Cameroons and of the results of a malaria survey of five predominantly rural districts made in January and February 1957, largely to investigate the relative prevalence of the disease in low-lying and highland areas. The infant parasite rates found were 61·5 per cent. in the lowlands and 45·6 per cent. in the highlands. A significant difference was also found in the percentages of very young children infected in the respective areas but not in older children or the sample as a whole. This implies that malaria is highly endemic even at high altitudes. The prevalent species of *Plasmodium* was *P. falciparum*, with *P. malariae* and *P. ovale* comparatively rare.

OKPALA (I.). **Transmission of** *Plasmodium gallinaceum* **through** *Aedes stokesi*.—*W. Afr. med. J.* (N.S.) **7** no. 4 pp. 195–196, 10 refs. Ibadan, 1958.

In experiments designed to assess the capacity of West African forest mosquitos to transmit *Plasmodium gallinaceum*, sporozoites were found in five out of seven females of *Aëdes stokesi* Evans from southern Nigeria examined 11–15 days after feeding on infected chickens, but the numbers were low. The infectivity rate was about the same as that found at the same time in *A. aegypti* (L.) [*cf. R.A.E.*, B **41** 169–170]. In similar tests, *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) was not infected.

IYENGAR (M. O. T.). **A review of the mosquito fauna of the South Pacific (Diptera: Culicidae).**—*Tech. Pap. S. Pacif. Comm.* no. 130, [4+] 102 pp., 1 fldg. map, 20 refs., multigraph. Noumea, 1960.

The present paper is designed to bring up to date the information in a previous publication by the author [*R.A.E.*, B **44** 193] on the mosquitos of the area of the South Pacific Commission's activities [**44** 181] and Tonga. The characteristics and affinities of the mosquito fauna are discussed, and as in the earlier paper most of the information given is on distribution. Mention is made of the species that transmit malaria and the periodic and non-periodic forms of *Wuchereria bancrofti*. The systematic list of species and subspecies now comprises 319 names (including six that relate to records of doubtful validity), and the reference to the original description is given in most cases, together with recent synonymy, data on distribution within the area, distributional status, *i.e.*, whether endemic, essentially endemic (occurring also in adjacent areas), Australian, Ethiopian-Oriental or cosmotropical, and, in the case of essentially endemic species, the range of distribution elsewhere.

STONE (A.). **A synoptic catalog of the mosquitoes of the world, supplement I (Diptera: Culicidae).**—*Proc. ent. Soc. Wash.* **63** no. 1 pp. 29–52. Washington, D.C., 1961.

This supplement to the "Synoptic catalog of the mosquitoes of the world" by A. Stone, K. L. Knight & H. Starcke [*R.A.E.*, B **48** 87], comprises corrections of errors in the original catalogue and entries derived from information published or made available since 1958. The latter include two additional subgeneric names and many additional specific names as well as new references and additions or corrections to distributional data or type information. One of the additional subgenera is *Alanstonea*, a subgenus of *Aëdes*, comprising *A.* (*Stegomyia*) *treubi* (de Meij.) (the type species of the subgenus) and *A.* (*S.*) *brevitibia* (Edw.) [*cf.* **44** 6].

MATHIS (W.), FAY (R. W.), SCHOOF (H. F.) & QUARTERMAN (K. D.). **Residual fumigants. Their potential in malaria eradication.**—*Publ. Hlth Rep.* **74** no. 5 pp. 379–381, 1 ref. Washington, D.C., 1959.

A fumigant action has been noticed in the effects of malathion on adults of *Anopheles quadrimaculatus* Say [*cf. R.A.E.*, B **49** 62], and an unexpected mortality of mosquitos observed in the laboratory was attributed to fumes from a sealed bag of fly bait containing malathion and dichlorvos (DDVP). In a test to confirm this, two cages containing adults of *A. quadrimaculatus* were placed 1·5 and 3·5 ft., respectively, above the floor in a small room, at sites about 7–10 ft. away from the bag of bait, which was on the floor of an adjoining room, and the rooms were closed to the exterior, with the communicating door left open; all the mosquitos died within 2·5 hours. Further tests were then undertaken to evaluate the fumigant action of bait containing 2 per cent. malathion and 0·5 per cent. dichorvos. Cages containing females of *Aëdes aegypti* (L.) and *Musca domestica* L. were placed in three different positions in a room, 5–8 ft. away from four double-walled paper bags with plastic linings, each containing 5 lb. of the bait, and similar cages of insects were placed in two positions in an adjoining room, 13 and 17 ft. away from the bait. One bag of bait was open and the others were left sealed, and insects were exposed for one hour while a gentle breeze passed through the two rooms. After 24 hours, the mortalities were 21–24 per cent. for *M. domestica* and 95–99 per cent. for *A. aegypti* in cages in a sheltered corner, an open window and an exposed corner of the first room, and 2 and 64 per cent. for *M. domestica* and *A. aegypti*, respectively, in an exposed corner and 0 and 52 per cent. in a sheltered corner of the second room. Tests were also carried out in two small huts, each with two open windows on opposite walls. In the first, a single open bag of the bait was placed in the centre of the floor, and in the second hut, three open bags were similarly installed. One week later, 100 females of *Anopheles quadrimaculatus* were released in each hut in the afternoon, and similar releases were made at weekly intervals for the next three weeks. On the morning after each release, living and dead mosquitos were collected, and mortality was determined after 24 and 48 hours. Complete mortality resulted on each occasion. During the fourth week, cages containing 25 females of *A. quadrimaculatus* were exposed for the same period of time on the floor of the huts, and at 2, 4 and 6 ft. above it. In the first hut, all the mosquitos at ground level and 2 ft. above, 44 per cent. of those at 4 ft. and 88 per cent. of those at 6 ft. were dead within the 48 hours observation period. In the second hut, complete mortality occurred at all levels. Formulations of 2 per cent. malathion and 0·5 per cent. dichlorvos, alone or in combination, were prepared in a granular inorganic material, and 5 lb. of each was put into an open paper container and placed in the centre of the hut floors. Three hours later, adults of *A. quadrimaculatus* were introduced, free or in cages, into each hut, and by the following morning all were dead. All the mosquitos were knocked down within 3·5 hours of being exposed to the combination of malathion and dichlorvos or to dichlorvos alone, but few were knocked down after being exposed to malathion alone for 4·5 hours.

Büttiker (W.). **Observations on feeding habits of adult Westermanniinae (Lepid., Noctuidae) in Cambodia.**—*Acta trop.* **16** no. 4 pp. 356–361, 4 refs. Basle, 1959.

Adults of *Lobocraspis griseifusa* Hmps. and a species of *Arcyophora* that is to be described as *A. sylvatica* were taken feeding at night on the lachrymal secretions of cattle and water buffalos used to attract mosquitos in Cambodia [*cf. R.A.E.*, B **43** 196]. Generally, the moths crawled to the lower edge of the eyes, and after some probing, the proboscis was extended between the cornea and the eyelid. Several times, 6–8 moths were seen clustering at the lower edge of the eyes of animals, and twice, a maximum of 12 was counted on a single eye. The moths seemed to cause very little irritation to the animals, and no great increase in lachrymation was noticed. Only rarely did the animals shake their heads causing the moths to take off, but sometimes even heavy shaking of the head did not disturb them. In several instances, moths were observed to feed incessantly for up to 10 or 15 minutes. Though rather photophobic when in flight, they were not disturbed by strong light when attached to the eyes. *Arcyophora* was rare, being only collected once; the more numerous *Lobocraspis* was found mainly in forest areas during cloudy weather. Traces of blood were found in the stomachs of two adults of *Lobocraspis* from an area where a buffalo was found to be blind in one eye, and examination revealed the presence of erythrocytes but not of spirochaetes, which might cause cattle ophthalmia; the blood corpuscles, however, were in an advanced state of digestion. Only three out of 15 stomach contents of *Lobocraspis*, subjected to precipitin tests for the presence of the blood of bovines, deer and horses, showed identifiable blood, which was bovine; one was from a male moth.

English (P. B.). **Notoedric mange in cats, with observations on treatment with malathion.**—*Aust. vet. J.* **36** no. 3 pp. 85–88, 5 figs., 13 refs. Sydney, 1960.

The following is based on the author's summary. Mange in cats caused by *Notoëdres cati* (Hering) was completely cured by immersing the animals twice, at intervals of 7–8 days, in aqueous suspensions of wettable malathion containing 0·25–1·25 per cent. toxicant, 0·5 per cent. being the most frequently used concentration. In tests of the toxicity of malathion to cats [*cf. R.A.E.*, B **44** 168], symptoms of poisoning were observed in one of four dipped in an 8 per cent. suspension and in two, one of which subsequently died, that were immersed in a 4 per cent. emulsion.

Papers noticed by Title only.

Sullivan (W. N.) & McCauley (T. R.). **Effect of acceleration force on insect mortality.**—*J. econ. Ent.* **53** no. 4 pp. 691–692, 3 graphs, 4 refs. Menasha, Wis., 1960. [See *R.A.E.*, A **49** 377.]

Mattingly (P. F.). **The Culicine mosquitoes of the Indomalayan area. Part V. Genus** *Aëdes* **Meigen, subgenera** *Mucidus* **Theobald,** *Ochlerotatus* **Lynch Arribalzaga and** *Neomelaniconion* **Newstead** [including extensions to the keys and addenda and corrigenda to earlier parts].—62 pp., 22 figs., 58 refs. London, Brit. Mus. (Nat. Hist.), 1961. Price 15*s*. [*Cf. R.A.E.*, B **47** 208, etc.]

SWELLENGREBEL (N. H.) & STERMAN (M. M.). **Animal parasites in man.**—$9\frac{1}{4} \times 6$ in., x+652 pp., 3 col. pls., 333 figs., many refs. Princeton, N.J., &c., D. Van Nostrand Co., Inc., 1961. Price $12 or £3 7*s*. 6*d*.

This is the first English edition, completely rewritten and enlarged, of a textbook of which several editions have appeared in Dutch [*cf. R.A.E.*, B **39** 15]. It is intended for biologists and physicians. It comprises six parts, of which three are on Helminths, one on Protozoa and one on arthropods of importance as parasites of man or as vectors of disease organisms; technique and diagnostic procedures are dealt with in the sixth part. Apart from the Linguatulids, the arthropods dealt with comprise ticks, mites, lice (*Pediculus humanus humanus* L. (*P. h. corporis* Deg.), *P. h. capitis* Deg. and *Phthirus pubis* (L.)), *Cimex* and Triatomine bugs, fleas and various Diptera. Data are given on the morphology and bionomics of the most important species or groups, with, as appropriate, mention of the effect they have on the host or of the disease organisms transmitted by them in various parts of the world. Keys are given to some genera and species. There is a very brief chapter on insecticides and repellents.

STONE (B. F.) & WEBBER (L. G.). **Cattle ticks,** *Boophilus microplus*, **resistant to DDT, BHC, and dieldrin.**—*Aust. J. agric. Res.* **11** no. 1 pp. 105–119, 3 graphs, 14 refs. Melbourne, 1960.

Cattle ticks (*Boophilus microplus* (Can.)) on a property in central Queensland, where DDT resistance had been demonstrated in March 1955, were not readily controlled by dipping infested cattle in 0·05 per cent. w/v γ BHC or in 0·05 per cent. w/v dieldrin after these chemicals had been in use for ten months (September 1955 to July 1956) and four months (July to November 1956), respectively. Spraying steers artificially infested with the fifth-generation progeny of ticks taken from this property in August 1957 indicated that resistance to DDT and dieldrin was still persisting, but the fourth laboratory generation of the same strain showed no resistance to diazinon. Immersion tests with third-generation larvae and fourth-generation engorged females of the same strain showed them to be, respectively, about 9 and 20 times as resistant to DDT in colloidal suspension as those of a susceptible reference strain at the 50 per cent. response level (the response being death for the larvae and failure to oviposit for the engorged females). The larvae were kept after treatment at 30°C. [86°F.] and the females at 20°C. [68°F.]. Tests with females kept at 30°C. showed that DDT was less toxic at the higher temperature in the resistant as well as the susceptible strain. The engorged females of the third laboratory generation showed more than 700-fold resistance to dieldrin when immersed in a wettable-powder suspension. When oil solutions of the insecticide were injected into them, engorged adult females of the same strain (second, third or fourth laboratory generation) showed 5- and 12-fold resistance to DDT and dieldrin, respectively, and some resistance to BHC, but none to coumaphos (Bayer 21/199). Similarly treated engorged females that were the first-generation progeny of ticks taken from the property in November 1958 showed eight-fold resistance to DDT.

FIEDLER (O. G. H.). **Die Wirkung insektizider Verbindungen auf parasitäre Milben mit besonderer Berücksichtigung des Hexachlorcyclohexans (HCH).** [The effect of insecticidal compounds on parasitic mites with special reference to BHC.]—*Wiss. Z. Univ. Halle* (Math.-Nat.) **8** pt. 6 pp. 1103–1115, 6 figs., 18 refs. Halle, 1959. (With summaries in English & Russian.)

When the presence of *Psorergates ovis* Wom. on merino sheep in South Africa was confirmed in 1954, investigations on the control of the mite were begun. It was found that the usual BHC dips were ineffective against it, although they killed other ectoparasites of sheep, but that it was susceptible to δ BHC [*cf. R.A.E.*, B **47** 143] and to a less extent ε BHC, though not to γ BHC or several other toxicants.

Laboratory tests were then carried out in which various chemicals were compared for their effect on *Psorergates ovis*, *Psoroptes ovis* (Her.) and *Demodex canis* Leydig in an oil, in which the mites lived long enough for valid results to be obtained. *Psoroptes* was found to be highly susceptible to γ BHC, endrin, isodrin, Chlorthion, dieldrin and δ BHC, in that order, *Psorergates* to Chlorthion, δ BHC, parathion, ε BHC, malathion and endrin, and *Demodex* to Chlorthion, parathion and ε and δ BHC. *Psoroptes* was immobilised within 24 hours by γ BHC at 156 and 78 parts per million, but by δ BHC only at 2,500 p.p.m. or above, and it was observed that the former affected the flexor muscles of the extremities and the latter the extensor muscles. At 313 p.p.m., γ BHC immobilised the mites in 5½ hours. *Psorergates* was immobilised by δ BHC at 625 p.p.m. in 3¾ hours and at 313 p.p.m. in over six hours and by ε BHC at 1,250 p.p.m. in six hours or more. *Demodex* was immobilised by δ BHC at 625 p.p.m. in 6½ hours. Mixtures of BHC isomers were then tested, and it was found that δ BHC reduced the action of γ BHC against *Psoroptes* and that ε BHC destroyed it completely but had no effect on the action of δ BHC, whereas α BHC had no effect on the action of γ BHC but accelerated that of δ BHC. Against *Psorergates*, γ BHC reduced the effect of δ BHC, and the effect was similar, though less marked, against *Demodex*. In subsequent tests, preliminary treatment with δ BHC reduced the effect of γ BHC on *Psoroptes*, and mites exposed to one of these and then the other lost the symptoms caused by the first on exposure to the second and acquired those of the latter, with a brief period of normal movement in between. In rats, both δ and ε BHC, particularly the latter, appeared to reduce the effects of γ BHC.

As a result of these tests, a dip containing a 4:1 mixture of δ and γ BHC used at a concentration of 800 p.p.m. δ BHC was developed and gave excellent control of all sheep ectoparasites in numerous field tests. Good control of *D. canis* on dogs, which are susceptible to γ BHC, was given by an 18:1 mixture of δ and γ BHC used at 4–5 per cent. as a skin application about six times at intervals of 3–4 days.

Eldefrawi (M. E.), Miskus (R.) & Hoskins (W. M.). **Resistance to Sevin by DDT- and parathion-resistant houseflies and Sesoxane as Sevin synergist.**—*Science* **129** no. 3353 pp. 898–899, 1 graph, 3 refs. Lancaster, Pa., 1959.

The effectiveness of Sevin, which has a low toxicity to *Musca domestica* L., was greatly increased when the insecticide was applied in combination with low concentrations of the synergist, sesamex (Sesoxane), to DDT-susceptible flies [*cf. R.A.E.*, B **48** 213]. Considerable resistance to Sevin, administered alone, was observed when acetone solutions were applied topically to females of *M. domestica* from parathion- and DDT-resistant strains, but a combination of Sevin and sesamex was effective against them, even at low dosages. There was very little difference between the rate of penetration of Sevin alone and in combination with the synergist, indicating that the effectiveness of the combination was not due to this factor.

Killough (R. A.). **Susceptibility of the ootheca of the American cockroach, *Periplaneta americana* (L.), to various insecticides.**—*Proc. Ind. Acad. Sci.* **68** (1958) pp. 196–198, 3 refs. Indianapolis, Ind., 1959.

In the experiments described, embryonic development of the eggs of *Periplaneta americana* (L.) was not inhibited by immersion in acetone solutions of DDT, chlordane, dieldrin, γ BHC (lindane) or malathion, but oothecae submerged for 15 or 60 seconds in a 2 per cent. solution of diazinon in acetone just before hatching was due showed inhibition of hatching. All the insecticides except DDT caused abnormality of some of the nymphs, which failed to shed the embryonic skin and died shortly after hatching. Topical treatment indicated that this was due to the presence of insecticides in the tubes of the keel, where they became available to the insects when hatching began; diazinon evidently penetrated more deeply. Temperature during incubation had no effect, and insecticide concentration and time of exposure had little, though diazinon caused more abnormality at 2 than at 0·5 or 1 per cent. and was more toxic with longer exposures. Since many cockroaches hatched normally, such treatments offer no prospects for satisfactory control.

Wolfe (H. R.), Walker (K. C.), Elliott (J. W.) & Durham (W. F.). **Evaluation of the health hazards involved in house-spraying with DDT.**—*Bull. World Hlth Org.* **20** no. 1 pp. 1–14, 4 figs., 13 refs. Geneva, 1959. (With a summary in French.)

The amount of DDT received by workers during indoor and outdoor spraying operations with DDT was measured to determine the main factors affecting exposure to the toxicant and to develop effective, acceptable protective measures and clothing. Potential dermal and respiratory exposures were estimated by measuring the DDT absorbed by pads attached to various parts of the operator's body or clothing, and by a filter-pad in a single-unit respirator, by a modification of the Schechter-Haller procedure [*R.A.E.*, B **35** 196]. Dermal exposure was found to be much greater than respiratory. When a 5 per cent. DDT spray was used, temperature, type of formulation (emulsion or wettable powder) and size of pump nozzle had little or no effect on exposure, which was, however, greater in applications to ceilings than to walls, and to smooth painted wood surfaces than to absorbent surfaces or surfaces on which a heavy deposit had already been built up, and increased with spray-pump pressure, but the latter could not be reduced below 30 lb. per sq. in. without affecting the evenness of the deposit obtained at a reasonable speed. A plastic cape, a hard hat with a plastic visor, and rubberised gauntlets gave a fully clothed man almost complete protection from dermal and respiratory exposure, but are not comfortable for outdoor work in the tropics, and a tropical helmet equipped with a plastic-netting veil is proposed for field testing; this gave good protection of the shoulders, back and chest, and excellent protection of the face and neck.

Fletcher (T. E.), Press (J. M.) & Wilson (D. B.). **Exposure of spray-men to dieldrin in residual spraying.**—*Bull. World Hlth Org.* **20** no. 1 pp. 15–25, 1 fig., 9 refs. Geneva, 1959. (With a summary in French.)

The following is based on the authors' synopsis. In a pilot scheme of house-spraying in East Africa in 1957–58, a study was made of the exposure of operators to dieldrin, and sources of contamination were enumerated.

Pads of filter paper were placed on the skin and outer clothing, and the amount of dieldrin absorbed was estimated. An operator, applying a daily average of 2·12 kg. dieldrin and observing the protective measures prescribed, received dermally 1·8 mg. dieldrin per kg. body weight daily, but this amount would probably be reduced by washing with soap and water upon completion of each day's work. The 16 operators and assistants were exposed for 180 days a year, during which time there was an interim period of two months between spray cycles. No clinical symptoms of poisoning were observed.

Mosna (E.), Rivosecchi (L.) & Ascher (K. R. S.). **Studies on insecticide-resistant Anophelines. 1. Chromosome arrangements in a dieldrin-selected strain of** *Anopheles atroparvus.—Bull. World Hlth Org.* **19** no. 2 pp. 297–301, 12 refs. Geneva, 1958. (With a summary in French.)

Mosna (E.), Palmieri (C.), Ascher (K. R. S.), Rivosecchi (L.) & Neri (I.). **2. Chromosome arrangements in laboratory-developed DDT-resistant strains of** *Anopheles atroparvus.—Op. cit.* **20** no. 1 pp. 63–74, 13 refs. 1959. (With a summary in French.)

The following paragraphs are substantially the authors' synopses of these two papers.

Cytological examination, by the technique developed by Frizzi [*cf. R.A.E.*, B **46** 204, etc.], showed heterozygous inversion in 77·4 per cent. of fourth-instar larvae of the 28th generation of a strain of *Anopheles labranchiae atroparvus* van Thiel selected by exposure of first- and third-instar larvae to dieldrin, and in only 20·8 per cent. of a normally susceptible strain, in which the standard chromosomal arrangement predominated. These results are similar to those obtained recently by other workers, who found heterozygous inversions in 74·8 per cent. of the larvae of the 12th generation of a DDT-selected strain of *A. l. atroparvus*.

As the resistance of the dieldrin-selected strain used in the experiments described in the first paper was comparatively low, the influence of the mode of selection on chromosome arrangement was investigated in DDT-resistant strains of *A. l. atroparvus* that had been selected by treatment of the larvae only (RL), of larvae and adult females (RLAF), and of adult females and males (RAFM). Their resistance was determined in the larval [*cf.* **43** 169] and adult stages [*cf.* **41** 156], mainly in the 32nd generation. The results were compared with those of the dieldrin-selected strain [RD] and several normal and semi-normal reference strains. In the larval assay, DDT-resistance followed the order RL>RLAF>RAFM>RD. For topical application to adults, the order was RLAF>RL>RAFM>RD, though the position of RL was doubtful since larval selection with DDT seemed to cause a rather strong variance in the reactions of the adults to topically applied DDT. For adult tarsal contact, the order was RAFM>RLAF>RL>RD. The DDT-resistant strains were examined cytologically, and the percentages of larvae with heterozygous inversions were 55·3, 54·0 and 24·4 for RL, RLAF and RAFM, respectively; those of all normal and semi-normal strains were about 12–21. DDT-resistance could not be correlated with the percentages of larvae showing heterozygous inversions found in the various strains.

Bransby-Williams (W. R.). **Effect of changes of temperature on the susceptibility to dieldrin of adult** *Aëdes aegypti.—Bull. World Hlth Org.* **20** no. 1 pp. 149–150, 5 refs. Geneva, 1959.

During routine susceptibility tests with *Aëdes aegypti* (L.) at Arusha, Tanganyika, it was found that the LC50 of dieldrin for unfed, newly-emerged females was 0·65 per cent. during June, when the mean monthly temperature was 16·5°C. [61·7°F.] and 0·12 per cent. in March and April, when the mean temperature was 21°C. [69·8°F.]. Tests were therefore made to determine whether these variations in susceptibility were due to differences in temperature. Females up to three days old that had not been offered a blood-meal were exposed to the toxicant by a slight modification of the Busvine & Nash technique [*R.A.E.*, B **41** 156], in which they were placed in glass tubes lined with filter papers treated with dieldrin in Risella oil. The exposures were made in two similar rooms, one of which had a temperature 5°C. [9°F.] higher than the other. After an exposure of one hour, the mosquitos were transferred to cages provided with sugar solution and kept at 15·5–19°C. [59·9–66·2°F.], and mortality was determined 24 hours later. Although the LC50 at 18–19°C. [64·4–66·2°F.] was about 0·8 per cent. as compared with about 0·3 per cent. at 24°C. [75·2°F.] [*cf.* **46** 193], the difference was not sufficient to account for the seasonal difference previously observed.

Chow (C. Y.), Lie Kian Joe, Winoto (R. M. P.), Rusad (M.) & Soegiarto. **The vector of filariasis in Djakarta and its bionomics.**—*Bull. World Hlth Org.* **20** no. 4 pp. 667–676, 7 refs. Geneva, 1959. (With a summary in French.)

An investigation was carried out in 1956–57 in a district on the outskirts of Djakarta, in Indonesia, to determine the vector of filariasis, caused by the nocturnal type of *Wuchereria bancrofti*, and its bionomics were studied. The following is based on the authors' synopsis of the results. *Culex pipiens fatigans* Wied. was the only species found harbouring the larvae of *W. bancrofti* in the area surveyed, and even in this mosquito the infection rate was very low [*cf. R.A.E.*, B **9** 8]; of 24,271 mosquitos dissected, 1·8 per cent. were infected with all stages of filarial larvae and 0·3 per cent. with mature infective larvae. Transmission occurred throughout the year with a maximum in September. The average number of *C. p. fatigans* caught each minute in night collections during a period of ten months was 2·2, and the average number of larvae of all stages of *W. bancrofti* per dissected mosquito was 0·12, so that the potential transmission index (the product of these two figures) [*cf.* **47** 60] was 0·26. In this district of Djakarta, the mosquitos were most numerous in July–August, preferred furniture, mosquito nets, and clothes and other objects hanging in the room as resting places [*cf.* **48** 35], and fed mainly after midnight.

Woodhill (A. R.). **Experimental crossing of** *Aëdes* (*Stegomyia*) *aegypti* **Linnaeus and** *Aëdes* (*Stegomyia*) *albopictus* **Skuse (Diptera, Culicidae).**—*Proc. Linn. Soc. N.S.W.* **84** pt. 2 pp. 292–294, 1 pl., 3 refs. Sydney, 1959.

The contradictory results obtained by earlier workers in attempts to cross *Aëdes aegypti* (L.) and *A. albopictus* (Skuse) are briefly summarised [*cf. R.A.E.*, B **46** 66], and an account is given of further experiments made in 1955–59, in which crosses were attempted between a strain of *A. aegypti* from Queensland (mainly var. *queenslandensis* (Theo.)) and a strain of *A. albopictus* from the Philippines and one from Singapore, and between single strains of each species from Hawaii. They involved 984 females of *A. aegypti* and 987 of *A. albopictus*. Pairing was observed frequently in all crosses, and living spermatozoa were observed in at least some of the females in most experiments. The females generally fed freely, but the number of eggs deposited did not always correspond with the number of blood-meals taken. A total of 49,649 eggs was deposited, of which only one hatched. This one, the product of a cross between a female of *A. albopictus* from Singapore and a male of *A. aegypti* from Queensland, gave rise to an adult male that showed dorsal thoracic markings combining the characters of the parent species. P. F. Mattingly, who examined the genitalia, considered that they resembled *A. albopictus* with some slight modification in the direction of *A. aegypti.*

Hernández-Corzo (J.), Barrera (A.) & Hecht (O.). **A method for bioassay of the effectiveness of residual spraying.**—*Mosq. News* **19** no. 2 pp. 91–94, 1 fig., 4 refs. Albany, N.Y., 1959.

A method is described for determining the duration of effectiveness of insecticide deposits against mosquitos under local conditions in sprayed houses. A flat circular plastic cover is used, having a small hole with a plastic cap through which mosquitos can be introduced. Perforations in the cover provide an outlet for the air with which the mosquitos are blown in and prevent concentrations of vapour from an insecticide that has a fumigant effect and the accumulation of humidity. The cover has a brim, by means of which it can be fixed to surfaces. Exposures of ten mosquitos, caught in the locality, were made under such covers affixed to the sprayed walls or surfaces under treatment (the tests), to pieces of cardboard lined with disks of paper or cloth impregnated with half the amount of insecticide that had theoretically been applied to the treated surfaces (the experimental controls), and to similar disks impregnated with the spray solvent. The mosquitos knocked down under each cover were counted at regular intervals and, when total knockdown had taken place, kept in recovery cages provided with sugar solution, mortality being determined 24 hours later. Comparison of knockdown and mortality rates in the tests with those in the experimental controls showed any decrease in the effectiveness of the deposits, and considerable survival in both tests and experimental controls would indicate a decreasing susceptibility and the necessity for more precise susceptibility tests [*cf. R.A.E.*, B **46** 214–215]. In tests with *Anopheles albimanus* Wied., *A. aztecus* Hoffm. and *A. quadrimaculatus* Say, it was found suitable to observe the knockdown every 20 minutes.

Gahan (J. B.) & Hoffman (R. A.). **Residual sprays for the control of** *Anopheles quadrimaculatus* **in buildings.**—*Mosq. News* **19** no. 2 pp. 95–99, 4 refs. Albany, N.Y., 1959.

Emulsion sprays of malathion, diazinon, DDT, dicapthon, fenchlorphos (ronnel), 2,4-dimethylbenzyl chrysanthemate and barthrin [6-chloropiperonyl chrysanthemate] were applied to the interior surfaces and to any equipment present in small wooden farm buildings with natural infestations of *Anopheles quadrimaculatus* Say in Stuttgart, Arkansas, in the summer of 1958. Counts were made of the numbers of *A. quadrimaculatus* in a building before and at various intervals during 11 weeks after treatment. At the rate of 200 mg. per sq. ft., malathion and diazinon both gave 100 per cent. control for three weeks; the first gave 95–99 per cent. control for the rest of the observation period, but the second had generally lost much of its effectiveness by the seventh or eighth week [*cf.* *R.A.E.*, B **48** 218]. Observations made within one hour after sunrise showed that neither was highly repellent. In all buildings sprayed at the same rate with DDT, dicapthon or fenchlorphos, control was complete, or nearly so, during the first week; in the third week, although mosquitos were found in all of them except one that had been sprayed with fenchlorphos, control was over 90 per cent. in most of them; after the fifth week control was never above 93 per cent. for DDT and was below 50 per cent. with the other two toxicants. Barthrin and 2,4-dimethylbenzyl chrysanthemate, at 200 mg. per sq. ft., both failed to give complete protection for two weeks in any of the buildings, and most of the treatments with them were less than 90 per cent. effective within three weeks. The 2,4-dimethylbenzyl chrysanthemate acted very quickly while it remained effective [**49** 138]; two weeks after the treatments, 2–12 adults of *A. quadrimaculatus* were found within an hour after sunrise in buildings sprayed with this insecticide at 400 mg. per sq. ft., as compared with more than 75 in those sprayed with barthrin at the same rate, and 150, 250 and 250 in those sprayed with malathion, diazinon and DDT, respectively, at 200 mg.

FAY (R. W.), BAKER (J. T.) & JENSEN (J. A.). **Radioactive tagging of** *Culex quinquefasciatus* **(Say) with** $\mathbf{P^{32}}$**.**—*Mosq. News* **19** no. 3 pp. 139–143, 3 refs. Albany, N.Y., 1959.

The following is based on the authors' summary of this account of investigations at Savannah, Georgia. In the laboratory, *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) produced 35 egg-rafts per 100 females over a period of four days, with an average number of 158 eggs per raft; the percentages of eggs hatching, of larvae pupating and of pupae producing adults were 98, 87 and 92·4, respectively, and equal numbers of each sex emerged. On the basis of these values, one million females of *C. p. fatigans* can be obtained for radioactive labelling by the collection of 100,000 pupae over a period of two days and rearing the eggs laid in the first four days by the resultant females, by the collection of about 16,000 egg-rafts within a period of four days and rearing the resultant larvae, or by a combination of both these methods. The highest concentration of larvae that could be used without a decrease in the number of adults obtained was 10,000 per sq. ft. of water surface, and by exposing larvae 6- to 8-days old at this concentration for 24 hours or longer in solutions containing 0·05–0·1 millicurie disodium hydrogen phosphate labelled with ^{32}P per litre of water, adults were obtained with radioactivity levels that were detectable for at least two weeks.

FAY (R. W.) & MORLAN (H. B.). **A mechanical device for separating the developmental stages, sexes and species of mosquitoes.**—*Mosq. News* **19** no. 3 pp. 144–147, 1 fig. Albany, N.Y., 1959.

A description is given of an apparatus for the rapid separation of the developmental stages, sexes and species of mosquitos that differ from each other in size. The culture is made to flow through the flattened metal spout of a funnel on to an inclined sheet of glass and then under a covering glass plate of which the upper edge is kept at a constant distance from the basal glass and the lower edge can be precisely adjusted to regulate the width of the lower aperture and so retain the larger organisms in the culture while the smaller ones drain into a container. The apparatus was used to separate pupae of a mixed batch of *Aëdes sollicitans* (Wlk.) and *A. taeniorhynchus* (Wied.) and to divide samples of pupae into male, mixed and female subsamples.

Gerhardt (R. W.). **The influence of soil fermentation on oviposition site selection by mosquitoes.**—*Mosq. News* **19** no. 3 pp. 151–155, 1 fig., 7 refs. Albany, N.Y., 1959.

It was observed in California in 1956 that experimental rice-field plots treated with chemicals that depressed algal growth were favoured by females of *Culex tarsalis* Coq. for oviposition, the mosquitos probably being attracted by an accumulation of fermentation products resulting from inefficient oxidation in the water. Experiments were carried out in 1957 to determine whether the presence of compounds resulting from the anaerobic decay of organic materials influenced the selection of oviposition sites by mosquitos [*cf. R.A.E.*, B **17** 86]. In the first, 13 shallow pits were dug and lined with polyethylene sheeting into which a 6-in. layer of rice soil was placed. Extra organic matter in the form of dog-meal containing 25 per cent. protein, 6 per cent. fat, 5 per cent. fibre and 10 per cent. ash was supplied to the soil, below the depth to which reducing conditions would extend, in five of the pits. All pits were then flooded with tap water to a depth of 6 in. and replenished daily. Eggs were observed in the treated pits after six days, when reducing conditions were well established and acid had accumulated in the surface water, and were present for several weeks. Examination of the resulting larvae showed that *Culex peus* Speiser predominated throughout the five weeks of the test, but *C. tarsalis* was abundant, and several examples of *Anopheles freeborni* Aitken were recovered during the last week. The control pits remained free of eggs. The pits were subsequently drained and cleaned, and three of the previous control pits were used in a supplementary experiment. Strong sucrose solution was injected into the soil of one of them, casein solution into that of the second, and the third pit received hydrogenated vegetable oil. Five days after flooding, eggs were found in all three pits, and larvae of *C. peus* resulted. Observations over 35 days showed that eggs continued to appear in the three pits for 15, 24 and 31 days, respectively, but no eggs were found in the untreated ones. In both experiments, eggs appeared on the day on which the pH of the water began to drop. The appearance of *C. peus* during the period of rapid fermentation confirms the preference of this species for foul water, and the appearance of *C. tarsalis* and *A. freeborni* with reduced fermentation conforms to the oviposition preferences of these species.

Jones (R. H.). *Culicoides* **breeding in human sewage sites of dwellings in Texas.**—*Mosq. News* **19** no. 3 pp. 164–167, 3 refs. Albany, N.Y., 1959.

Surveys were begun in 1955 on the natural breeding sites of *Culicoides variipennis sonorensis* Wirth & Jones, a possible vector of the blue-tongue disease of sheep [*cf. R.A.E.*, B **42** 147], near Kerrville, Texas, and the following is taken from the author's summary of the results. Four good breeding places were found, three with a heavy and one with a moderate population, at the outlets of sewage disposal systems, where waterborne sewage or sewage effluent seeped out on to the ground [*cf.* **46** 195]. Two of these sites were apparently caused by the effluent from a septic tank, and the other two from the discharge of raw sewage. Larvae were most numerous in areas of exposed mud surrounded by a dense cover of Bermuda grass [*Cynodon* *dactylon*] and were not found in areas thickly covered with weeds. Small numbers of Psychodids were always present in association with *C. v. sonorensis*, but a dense population of one apparently precluded a large population of the other. A survey in the summer of 1957 covered 69 sites that appeared to be suitable for the breeding of *C. v. sonorensis*, of which 26 were associated with sewage effluent, but heavy and moderately heavy breeding, respectively, was found in two sites only, the others showing little or none. Breeding occurred throughout the year, but populations were lowest in winter. Small numbers of *C. crepuscularis* Mall. and *C. haematopotus* Mall. were usually found in association with large populations of *C. v. sonorensis*.

LOOMIS (E. C.) & HANKS (S. G.). **Light trap indices of mosquito abundance: a comparison of operation for four and seven nights a week.**—*Mosq. News* **19** no. 3 pp. 168–171, 1 fig., 2 refs. Albany, N.Y., 1959.

The following is based on the authors' summary. The operation of American model light-traps for either four or seven nights a week gave similar indices of the seasonal trends of the population of *Culex tarsalis* Coq. in the Central Valley of California in 1954–55 under a variety of conditions and in different places [*cf. R.A.E.*, B **31** 198].

BULLOCK (H. R.), MURDOCH (W. P.), FOWLER (H. W.) & BRAZZEL (H. R.). **Notes on the overwintering of** *Culex tritaeniorhynchus* **Giles in Japan.**—*Mosq. News* **19** no. 3 pp. 184–188, 23 refs. Albany, N.Y., 1959.

The virus of Japanese B encephalitis has been isolated from *Culex tritaeniorhynchus* Giles [*cf. R.A.E.*, B **40** 163, etc.; **46** 59], and adults were collected in the Kanto Plain area, Honshu, from September 1957 to February 1958 to determine whether this species overwinters in the adult stage. Routine dissections of overwintering females of *C. pipiens* L. were made to establish criteria for determining whether a female mosquito collected in winter was in true hibernation. All the females of *C. tritaeniorhynchus* collected were in hibernation, as shown by the presence of developed fat-bodies in the abdomen and of spermatozoa in the spermathecae, lack of ovarian development and the absence of evidence of recent engorgement. They were found mainly in brush and wood piles of the common pine (*Pinus densiflora*), but they were also collected from bundles of bamboo (*Pseudosasa japonica*), wood piles of *Zelkova serrata* and *Quercus acuta*, and from a cave. At a distance of 20 in. from the edge and surface of a pine brush pile, the winter temperature ranged from 14 to −1°C. [57·2 to 30·2°F.] and the relative humidity from 76 to 91 per cent. In laboratory studies, females of *C. tritaeniorhynchus* fed on a diet of sugar solution developed fat-bodies when exposed to light for less than 15 hours per day [*cf.* **48** 68]. If this occurs in nature, and *C. tritaeniorhynchus* does not take a blood-meal before hibernating, it seems unlikely that this species harbours virus during the winter unless transovarian transmission occurs.

METSELAAR (D.). **Two malaria surveys in the central mountains of Netherlands New Guinea.**—*Amer. J. trop. Med. Hyg.* **8** no. 3 pp. 364–367, 16 refs. Baltimore, Md., 1959.

Malaria surveys were carried out in 1958 in two valleys in Netherlands New Guinea, until recently untouched by Western culture. In the Baliem valley, which lies at an altitude of about 5,300 ft. and in which human infections were rare, adults of *Anopheles farauti* Lav. and *A. koliensis* Owen were taken biting in the evenings and a few resting in houses in the mornings [*cf. R.A.E.*, B **44** 142, etc.], but on their dissection, no parasites were found. The other survey was carried out in the Kemaboe valley towards the end of a malaria epidemic. In this valley, traffic is more intense owing to the presence of a salt well at about 4,600 ft., which may have contributed to the spread of the disease. A few larvae of *A. koliensis* were collected near an airfield at about 5,300 ft., but not one was found higher up. On the mountain ridges a few *Culex* larvae were found in places that also looked suitable for the breeding of members of the group of *A. punctulatus* Dön. It was thought that an unusual drought may have been responsible for the epidemic by allowing the production of more Anophelines than usual in breeding places on steep slopes that are normally flushed out by rain and by the rapid completion of the extrinsic cycle of the parasite resulting from the higher temperatures. The findings of those surveys and of others in different areas are discussed in relation to the definition of endemicity in New Guinea and at such altitudes [*cf.* **48** 83, etc.].

CAUSEY (O. R.) & MAROJA (O.). **Isolation of yellow fever virus from man and mosquitoes in the Amazon region of Brazil.**—*Amer. J. trop. Med. Hyg.* **8** no. 3 pp. 368–371, 2 refs. Baltimore, Md., 1959.

Yellow-fever virus was isolated from ten men blazing trails in the Oriboca Forest, in the Amazon region of Brazil, in 1954 and 1955. Nine of the isolations were made soon after the beginning of the work in November and December 1954, three of them being from men who had been working in an area known to be inhabited by a band of howler monkeys (*Alouatta*). No further cases of yellow fever were found in 1954, and it seemed that this was due partly to the retreat of these and other monkeys from the area. Three months later, the tenth isolation was made from a man who had been working in a part of the forest towards which the howler monkeys were known to have retreated. Four strains of yellow-fever virus were isolated from mosquitos caught in the Oriboca Forest between December 1954 and April 1955, one from a pool of *Aëdes* and Sabethine mosquitos, two from pools of *Haemagogus* [*cf. R.A.E.*, B **40** 134], and one from a pool of Sabethines. In April and May 1955, yellow-fever virus was isolated from 11 forest dwellers of various ages in the Apeu Forest, where the inhabitants cultivate small clearings, near which monkeys of the genus *Saimiri* are numerous.

GREENBERG (B.). **Persistence of bacteria in the developmental stages of the housefly. I. Survival of enteric pathogens in the normal and aseptically reared host.**—*Amer. J. trop. Med. Hyg.* **8** no. 4 pp. 405–411, 6 figs., 11 refs. Baltimore, Md., 1959. **II. Quantitative study of the host-contaminant relationship in flies breeding under natural conditions.**—*T.c.* pp. 412–416, 4 graphs, 6 refs.

The following paragraphs are based, respectively, on the author's summaries of these two papers.

When *Shigella flexneri* and *Salmonella typhi* were introduced into a normally contaminated CSMA medium for rearing larvae of *Musca domestica* L. [*R.A.E.*, B **44** 113], they were recovered infrequently from the larvae and not at all from the resulting adults. Under similar conditions, *S. paratyphi* B was recovered from adults and, more frequently than the other species, from larvae, but from a smaller percentage of adults than larvae. *S. typhi*, introduced into the medium after it had been sterilised [*cf. loc. cit.*], appeared to multiply to some extent whether larvae were present or not. When these bacteria or *S. enteritidis* were introduced into the sterilised medium, they were recovered regularly from larvae and pupae of *M. domestica* of various ages. Full-fed larvae typically harboured about 10^7 organisms, and pupae from the second day to emergence contained 10^3–10^4. Some pupae contained few bacteria or none.

Proteus vulgaris, *P. mirabilis*, *Escherichia freundii*, and *Aerobacter aerogenes* survived metamorphosis of *M. domestica*, and were recovered from adults emerging from cultures in CSMA medium in the laboratory and in horse manure under natural conditions. The numbers of bacteria present in full-fed larvae, prepupae, pupae and adults reared in CSMA medium and under natural conditions in horse manure, privy contents and refuse were estimated. Full-fed larvae were found to support populations of 10^7 bacteria, and the prepupae, 10^5–10^6. At the beginning of pupation, the counts ranged from 10^4–10^5, and this range was maintained during metamorphosis. Most emerging adults retained 10^2 or 10^3 bacteria, but the range was 0–10^6. Comparison of infection with single species of *Shigella* or *Salmonella*, dual infection with *S. enteritidis* and *P. rettgeri*, and multiple infection with a saprophytic flora led to the conclusion that all these organisms respond similarly to the same host factors, as was shown by the essentially uniform pattern of survival in every case.

GALINDO (P.), DE RODANICHE (E.) & JOHNSON (C. M.). **St. Louis encephalitis in Panama. I. Isolation of the virus from forest mosquitoes and human blood.**—*Amer. J. trop. Med. Hyg.* **8** no. 5 pp. 557–560, 1 map, 12 refs. Baltimore, Md., 1959.

St. Louis encephalitis virus was isolated in Panama from mosquitos collected at Buena Vista, near the Canal Zone, and later at Paya and Tacarcuna, near the Colombian border. It was also isolated at Paya in February 1958 from the blood of a man employed in collecting mosquitos, and again in September from the blood of a man, engaged in field studies, who had become ill six days after allowing females of *Sabethes chloropterus* (Humb.), *Haemagogus spegazinii falco* Kumm., Osorno & Boshell and *Aëdes leucocelaenus* D. & S. to feed on him. The virus was isolated at Buena Vista in July 1957 and at Tacarcuna in September 1958 from pools of 95 and 114 females of *S. chloropterus*, respectively, and at Paya in June 1958 from a pool of 133 females of *S. chloropterus*, in July from a pool of 139 mosquitos, consisting of *S. cyaneus* (F.), *S. undosus* (Coq.), *S. fabricii* Lane & Corqueira, *S. tarsopus* D. & K., and a species related to *S. tarsopus*, and in August, from a pool of 153 females of *S. chloropterus*.

HARRIS (W. G.) & BURNS (E. C.). **Phosphate resistance in a field strain of house flies.**—*Amer. J. trop. Med. Hyg.* **8** no. 5 pp. 580–582, 1 graph, 9 refs. Baltimore, Md., 1959.

As failure of malathion to control *Musca domestica* L. was reported from a poultry farm in Louisiana where the insecticide had been used exclusively for about three years, studies were undertaken to determine whether the flies had become resistant to it, and their resistance to DDT, methoxy-DDT (methoxychlor), coumaphos (Bayer 21/199), fenchlorphos (Korlan), diazinon, dicapthon and γ BHC (lindane); chlorinated insecticides, mainly DDT, had been used on the farm before malathion. A colony of the flies was established in October 1957, and acetone solutions of the insecticides were applied topically to females 3–5 days old from this and from a colony of normal flies. The field strain was found to be highly resistant to malathion and DDT and to show varying but lower degrees of resistance to the other compounds. No loss of resistance to malathion or DDT was apparent in the 12th generation of the field strain, but there was a great loss by the 17th generation, when the LD50's had dropped from 29 μg. per fly in the third generation to 3·4, and from over 100 μg. per fly in the first generation to 2·4, respectively. Development was slower in the field strain than in the susceptible one [*cf. R.A.E.*, B **39** 182] so that the loss in resistance between the 12th and 17th generations may have resulted from selection during rearing that favoured the susceptible individuals. Progeny of flies taken from the farm in October and December 1958 were found to be more resistant to malathion than individuals of the original field strain.

KILPATRICK (J. W.) & SCHOOF (H. F.). **Interrelationship of water and *Hermetia illucens* breeding to *Musca domestica* production in human excrement.**—*Amer. J. trop. Med. Hyg.* **8** no. 5 pp. 597–602, 1 fig., 4 refs. Baltimore, Md., 1959.

As it was found that breeding of *Musca domestica* L. in human excrement increased when privies were treated with insecticides, and particularly with dieldrin [*cf. R.A.E.*, B **46** 161, etc.], studies were made in Georgia in 1955–58 to determine the factors responsible. The following is substantially the authors' summary of the results. Few adults of *M. domestica* emerged from untreated privies; treatment with dieldrin, BHC or chlordane greatly increased the production of flies, but DDT, malathion and diazinon had little or no effect. Eggs of strains of *M. domestica*, resistant to DDT or dieldrin or both, introduced into treated privies, produced 16–258 times as many adults as when introduced into untreated privies [*cf.* **46** 131; **49** 6]. Larvae of *Hermetia illucens* (L.) and semiliquid contents occurred in untreated privies, but were rare in treated ones. The drainage of water from privies or the addition of sawdust or soil caused an increase in the numbers of *M. domestica* similar to that caused by treatment with dieldrin. It is concluded that the increase in the production of *M. domestica* in treated privies results from the more solid nature of the contents that accompanies a reduction in the number of *H. illucens*, the larvae of which keep the media semiliquid. Resistance of *M. domestica* to insecticides would contribute to the phenomenon, enabling them to survive contact with compounds that are highly lethal to *H. illucens*.

SØMME (L.). **On the number of stable flies and house flies on Norwegian farms.**—*Norsk ent. Tidsskr.* **11** pt. 1–2 pp. 7–15, 16 graphs, 16 refs. Oslo, 1959.

The following is virtually the author's summary. By collecting flies and making regular observations on the numbers of *Stomoxys calcitrans* (L.), *Musca domestica* L. and *Fannia* spp. in cow-houses and piggeries on farms within 90 km. of Oslo, it was found that *S. calcitrans* made up the largest part of the fly population in cow-houses, whereas *M. domestica* predominated in piggeries. Of 5,954 flies observed in 11 cow-houses during the summers of 1956 and 1957, 15·3 per cent. were *M. domestica*, 74·5 per cent. *S. calcitrans* and 10·2 per cent. *Fannia*. Of 2,304 flies observed in 10 piggeries at the same time, 56·5 per cent. were *M. domestica*, 17·7 per cent. *S. calcitrans* and 25·8 per cent. *Fannia*. Other species of the family Muscidae appeared in only small numbers.

SØMME (L.). **Control of stable flies by Dipterex on Norwegian farms.**—*Norsk ent. Tidsskr.* **11** pt. 1–2 pp. 16–19, 3 refs. Oslo, 1959.

The following is based on the author's summary. Field tests were carried out in five cow-houses 50 km. north of Oslo during the summer of 1958 to examine the possibility of controlling *Stomoxys calcitrans* (L.) by a commercial insecticide containing 6·5 per cent. trichlorphon (Dipterex) and 93·5 per cent. additives. The insecticide was mixed with water and applied in strips as a bait by means of a brush, and the numbers of *S. calcitrans* were usually reduced by 70–80 per cent. one week after application. This level of control was maintained for 2–3 weeks during the summer and for as long or longer in autumn. It is concluded that trichlorphon gives satisfactory control of *S. calcitrans* if applied in a proper way 3–4 times during the fly breeding season.

HAFEZ (M.) & GAMAL-EDDIN (F. M.). **Ecological studies on *Stomoxys calcitrans* L. and *sitiens* Rond. in Egypt, with suggestions on their control (Diptera: Muscidae).**—*Bull. Soc. ent. Egypte* **43** pp. 245–283, 13 figs., 3 pp. refs. Cairo, 1959.

The following is based on the authors' summary. *Stomoxys calcitrans* (L.) and *S. sitiens* Rond. are extremely abundant at a sewage farm to the west of Cairo, living mainly in an artificial forest, in which they rest, feed and breed. The climatic conditions of the area are described, and observations on the flies are recorded. Both are typically outdoor insects, but *S. sitiens* prefers cultivated semi-arid localities, especially those at the edge of the desert. Peak breeding occurs in May for *S. calcitrans* and June for *S. sitiens*, and cattle, horse or donkey dung mixed with straw and wetted with urine, and decaying leaves, formed attractive oviposition and breeding media for both species. Details of the life-cycle are given, and suggestions for control are made.

HAFEZ (M.) & GAMAL-EDDIN (F. M.). **On the feeding habits of *Stomoxys calcitrans* L. and *sitiens* Rond., with special reference to their biting cycle in nature (Diptera: Muscidae).**—*Bull. Soc. ent. Egypte* **43** pp. 291–301, 4 graphs, 14 refs. Cairo, 1959.

In Egypt, *Stomoxys calcitrans* (L.) and *S. sitiens* Rond. [*cf.* preceding abstract] are severe pests of cattle and other domestic animals, taking blood voraciously and inflicting severe wounds in so doing. Their feeding habits were investigated in the laboratory and field, and the following is based on the authors' summary of the results. *S. sitiens* depends on and prefers donkey blood. Camel was second in order of preference, followed by horse, buffalo, cow, sheep and goat. *S. calcitrans* also preferred donkey, followed by horse, buffalo, cow, camel, sheep and goat. The time taken to engorge varied with temperature. For *S. calcitrans*, it averaged 7 minutes at 30°C. [86°F.] and 15 minutes at 21°C. [69·8°F.]. The time required for digestion also varied. When fed on human blood, a female of *S. calcitrans* digested the meal in about 14 hours 36 minutes at 30°C. and about 21 hours 11 minutes at 25°C. [77°F.]. Only half as long was required for citrated calf blood. Studies on the biting cycle showed two peaks of activity in the hot months, one in the morning and one in the late afternoon, with a marked drop about noon. In the colder season, both species have a single peak, at about 2 p.m. *S. sitiens* generally showed more biting activity than did *S. calcitrans*. The mechanism of feeding of the two species is described.

Rodriguez jr. (J. L.) & Riehl (L. A.). **Control of northern fowl mite in community wire cages with malathion in special dust-bath-boxes.**—*J. econ. Ent.* **53** no. 5 pp. 701–704, 4 refs. Menasha, Wis., 1960.

Experiments were carried out on two poultry farms in southern California in 1957 and 1958 to determine the effectiveness of malathion in dust-bath boxes [*cf. R.A.E.*, B **46** 45] for the control of *Ornithonyssus sylviarum* (C. & F.) on fowls in wire-netting cages containing 70–100 hens each. The following is based on the authors' abstract. It was found that when one box containing 5 lb. 4 per cent. malathion dust was left in a cage for 14 days, the mite was effectively controlled for the next six weeks. When this treatment was confined to those heavily infested cages in which mites were found on the eggs, control was still effective. Additional trials showed that 1 lb. 4 per cent. malathion dust per box per 30 hens was the optimum rate for control of the mite. It was found that boxes with a depth of 3 in. were more acceptable to hens than deeper boxes, and were also preferable because eggs were not laid in them.

Nagasawa (S.). **The toxic action of a mixture of Sevin and p,p′-DDT to the house fly.**—*J. econ. Ent.* **53** no. 5 pp. 709–711, 1 graph, 8 refs. Menasha, Wis., 1960.

Experiments were carried out to determine the relative toxicities of Sevin and p,p′DDT to *Musca domestica* L., and the type of joint toxic action exhibited by a 2:1 mixture of the two. The insecticides were applied topically in acetone to females, 3–5 days old, with acetone alone as a control. The LD50's for Sevin and p,p′DDT, were, respectively, 3·102 and 0·357 μg. per fly, and the dosage-mortality regression lines of the two toxicants were parallel within the limits of experimental error. The results for the mixture indicated that the two insecticides have different types of toxic action, that the toxicity of the mixture is due mainly to the more effective component (p,p′DDT) when low concentrations are used and that the effect of the Sevin is most apparent at high concentrations, when the effect of the p,p′DDT has approached a maximum. The effectiveness of the mixture depends on the total concentration of insecticide, and, as the concentration increases, the proportionate toxic action of Sevin to p,p′DDT will change smoothly from 0 to 1.

Drummond (R. O.) & Moore (B.). **Effects of timing and method of application on efficiency of Co-Ral sprays for cattle grub control.**—*J. econ. Ent.* **53** no. 5 pp. 729–731, 10 refs. Menasha, Wis., 1960.

Experiments were conducted in Texas in 1958 to determine the effects of the time of application, the concentration used, and the rate and pressure at which sprays were applied on the effectiveness of coumaphos (Co-Ral) against *Hypoderma* larvae in cattle. Spraying of cattle with 1 U.S. gal. 0·5 per cent. coumaphos per beast at monthly intervals from May to September gave 83–99 per cent. control from December to February, and the variations were not related to the times of application. In tests in which cattle were sprayed with either 0·75 or 1 U.S. gal. 0·4 or 0·5 per cent. coumaphos, the control percentages averaged 89, and there was no difference between that given by either of the quantities or concentrations, but it was only 31 when long-haired calves were treated with about 0·25 U.S. gal. of a 0·4 or 0·5 per cent. spray. Spraying with 0·5, 1, and 1·5 U.S. gal. 0·5 per cent. coumaphos at a pressure of 250 lb. per sq. in. and with 1 U.S. gal. at 500 lb. per sq. in. gave, respectively, 95, 95, 94 and 97 per cent. control.

Jones (R. H.). **Mass-production methods for the colonization of** *Culicoides variipennis sonorensis*.—*J. econ. Ent.* **53** no. 5 pp. 731–735, 3 figs., 1 ref. Menasha, Wis., 1960.

A colony of *Culicoides variipennis sonorensis* Wirth & Jones that had been established at Kerrville, Texas, in 1947 [*R.A.E.*, B **46** 49], died out after 12 generations; large numbers of the insect had never been produced. Details are given of routine methods subsequently evolved whereby a colony was established that produced an average of 1,000 adults per day for a year. Only half the viable eggs produced were needed for maintenance at this strength. The midges were kept in polyethylene containers with a capacity of 6 U.S. quarts, and were given the opportunity to feed for 1–3 hours, four times a week, on the belly of a rabbit on to which they were attracted by a dim beam of light, the rest of the room being kept dark during feeding. Illumination was by sun-lamps operated during working hours, and a half-hour period of twilight was provided daily except during week-ends. Mud, on a paper disc lying on a thick layer of wet cotton, was provided for oviposition, and yeast was added to the mixture of cowdung, black soil and water in the pans of the larval rearing racks, in which a free flow of water was maintained. The equipment could be easily modified for use with smaller numbers or to maintain a much larger colony. In the two years for which it has been maintained, the colony became adapted to laboratory conditions, the percentage of females taking a blood-meal having increased.

Forgash (A. J.) & Hansens (E. J.). **Further studies on the toxicity of insecticides to diazinon-resistant** *Musca domestica*.—*J. econ. Ent.* **53** no. 5 pp. 741–745, 5 graphs, 11 refs. Menasha, Wis., 1960.

The following is substantially the authors' summary of the results of studies in New Jersey on the extent of cross-resistance in a diazinon-resistant field strain of *Musca domestica* L. [*R.A.E.*, B **47** 167] to other insecticides [*cf.* **48** 196]. The materials tested, with (in brackets) the factor by which the tolerance of the resistant strain at the LD50 level, as determined by topical application in acetone, exceeded that of a susceptible laboratory strain, were diazinon (87), heptachlor (468), heptachlor epoxide (809), barthrin [6-chloropiperonyl chrysanthemate] (3), demeton (12), phorate (17), dimethoate (3), dichlorvos (DDVP) (4), dicapthon (18), Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate) (4), mevinphos (Phosdrin) (7), Am. Cyanamid 18706 (O,O-dimethyl S-ethylcarbamoylmethyl phosphorodithioate) (5), Thiodan (58), fenthion (Bayer 29493) (8), G-30494 (O,O-dimethyl S-2,5-dichlorophenylthiomethyl phosphorodithioate) (12), Dimetilan

(3-methyl-5-pyrazolyl dimethylcarbamate) (6), trichlorphon (Dipterex) (7), Delnav (2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)) (89), DMBC (2,4-dimethylbenzyl chrysanthemate) (3) and Thanite (34).

Harvey (T. L.) & Brethour (J. R.). **Feed additives for control of house fly larvae in livestock feces.**—*J. econ. Ent.* **53** no. 5 pp. 774–776, 12 refs. Menasha, Wis., 1960.

The following is mainly the authors' abstract. There was no significant reduction in the numbers of *Musca domestica* L. developing in the dung of a steer that ingested up to 100 g. Polybor 3 (containing 98 per cent. disodium octaborate tetrahydrate) daily [*cf. R.A.E.*, B **48** 165], but when mixed directly with the dung, at the rate of 1 g. per kg., the compound was an effective larvicide. It is thought that, because of its solubility, a larger amount of ingested Polybor 3 is eliminated in the urine of cattle than in the dung, and this may account for the failure of control when the compound was given in the feed.

When 1-kg. samples of the dung alone, and mixed with 50, 100, 200 and 300 mg. of a preparation containing 25 thousand million spores of *Bacillus thuringiensis* [*cf.* **49** 3] per g. were infested with 100 eggs of *M. domestica*, 43, 41, 9, 5 and 0 flies emerged, respectively. No house-flies developed in the dung of a steer fed daily with 20 g. of the preparation of *B. thuringiensis*, and their numbers were greatly reduced when 0·125 g. of the preparation per kg. was added to the feed of hens. The presence of aureomycin in cattle feed did not decrease the effectiveness of *B. thuringiensis*.

Darrow (D. I.) & Plapp (F. W.). **Studies on resistance to malathion in the mosquito,** *Culex tarsalis*.—*J. econ. Ent.* **53** no. 5 pp. 777–781, 17 refs. Menasha, Wis., 1960.

DDT, dieldrin and 19 organophosphates, including malathion and four compounds closely related to it, were compared for their toxicity to fourth-instar larvae of *Culex tarsalis* Coq. of a field strain and of a susceptible laboratory strain, in order to determine the cross-resistance of the former, which was 60-times as resistant to malathion as the laboratory strain and had a five-fold resistance to DDT when it was obtained; resistance to malathion had been maintained by routine exposure of fourth-instar larvae to the toxicant and had remained nearly constant for two years. Resistance was shown only to coumaphos (Co-Ral), DDT and dieldrin among the materials not related to malathion and was only two- to threefold; it was sevenfold to malaoxon (O,O-dimethyl S-(1,2-di(ethoxycarbonyl)ethyl) phosphorothioate) and the diethyl homologue of malathion (O,O-diethyl S-1,2-di(ethoxycarbonyl)ethyl phosphorodithioate), but none was shown to acethion (O,O-diethyl S-ethoxycarbonylmethyl phosphorodithioate) or its dimethyl homologue. From these tests it appeared that a single ethoxycarbonyl group was not enough to confer resistance but that two were needed, and that resistance was not due to a failure in the mechanism that converts malathion into malaoxon. Tests with malathion and acethion labelled with ^{32}P showed that detoxification of malathion proceeded at about the same rate in larvae of the resistant and the susceptible strains, and is effected largely by hydrolysis at the ethoxycarbonyl bonds in both strains.

MULLA (M. S.). **Loss of activity of chlorinated hydrocarbon insecticides in soil as measured against the eye gnat,** *Hippelates collusor*.—*J. econ. Ent.* **53** no. 5 pp. 785–787, 9 refs. Menasha, Wis., 1960.

The duration of effectiveness of DDT, endrin, γ BHC (lindane), dieldrin, aldrin and SD-4402 (1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan) in soil treatments against *Hippelates collusor* (Tns.) [*cf. R.A.E.*, B **49** 152] was studied in the laboratory. Sand was sprayed with the insecticides at the rate of 100 U.S. gal. per 6-in. acre and stored in jars at about 88°F. At intervals of three months, eggs of *H. collusor* were added to mixtures of the treated sand and organic matter, and the adults emerging were counted. The dosages of the six insecticides, which were 26, 4·8, 32, 30, 18 and 1·5 lb. per acre, respectively, corresponded to the initial LD90's of these compounds, as reported in work already noticed [**49** 117]. There was no apparent loss in the effectiveness of DDT, endrin or γ BHC after nine months, or in that of dieldrin after 12 months. The loss of activity of aldrin and (in brackets) SD-4402, after 3, 6, 9 and 12 months, was 53 (40), 60 (72), 77 (74) and 70 (66) per cent., respectively.

LABRECQUE (G. C.), ADCOCK (P. H.) & SMITH (C. N.). **Tests with compounds affecting house fly metabolism.**—*J. econ. Ent.* **53** no. 5 pp. 802–805, 11 refs. Menasha, Wis., 1960.

The following is substantially the authors' summary of the results of tests in 1958 in which 200 compounds were screened for their ability to sterilise or otherwise interfere with the development of *Musca domestica* L. The chemicals were introduced into the larval medium or the food of adults. Of the compounds tested, 79 had adverse effects on some stage of development when added to the larval medium, and ten were toxic or prevented reproduction when added to the food of the adults; of the latter, amethopterin (N-(p-((2,4-diamino-6-pteridylmethyl)methylamino)benzoyl)-glutamic acid) was the most promising, causing sterility of females at a dosage of 0·005 g. per 50 g. food. When amethopterin was given in their initial meal, it caused sterility in the females, but not in the males, and it reduced subsequent oviposition when given in a later meal. Oviposition of females given access to both food treated with amethopterin and untreated food was only about 2 per cent. of that of females given untreated food only.

GOODHUE (L. D.). **New techniques for screening cockroach repellents.**—*J. econ. Ent.* **53** no. 5 pp. 805–810, 2 figs., 4 refs. Menasha, Wis., 1960.

The following is based mainly on the author's abstract. Two methods are described for evaluating the repellency of chemicals to cockroaches. One was based on the tendency of the insects to crawl up a slanting surface, and was especially effective for use with *Blattella germanica* (L.). Cards impregnated with chemicals and an untreated card were placed in a slanting position against the inside walls of a transparent plastic box containing the cockroaches, and the numbers of insects on them compared after an hour. The other was more suitable for use with larger species, such as *Periplaneta americana* (L.). Adults of *P. americana* were placed in three intercommunicating glass cylinders that were arranged in a row and had been ground on the inside so as to confine the insects to filter papers or other surfaces at the bottom. Treated filter papers were introduced into the two outer cylinders and an untreated paper into the middle one, and the numbers of cockroaches on the papers were compared after two days. Of over 1,000 chemicals tested in this way, the most effective were 2,3,4,5,-bis(Δ^2-butenylene)-tetrahydrofurfural [*cf.* *R.A.E.*, B **40** 96], 2-hydroxyethyl n-octyl sulphide, 2-hydroxypropyl n-octyl sulphide and tert.-butylsulphenyl dimethyldithiocarbamate. MGK 264 (N-(2-ethylhexyl)bicyclo(2.2.1)-5-heptene-2,3-dicarboximide) was found to be synergistic with the furfural. Although highly effective, the dimethyldithiocarbamate was more toxic and had more odour than the furfural or 2-hydroxyethyl n-octyl sulphide, and, of the latter, the furfural appeared to be the better repellent.

Rogoff (W. M.) & Kohler (P. H.). **Effectiveness of Ruelene applied as localized " pour-on " and as spray for cattle grub control.**—*J. econ. Ent.* **53** no. 5 pp. 814–817, 1 fig., 8 refs. Menasha, Wis., 1960.

An emulsion concentrate containing 4 lb. Ruelene (O-methyl O-4-tert.-butyl-2-chlorophenyl methylphosphoramidate) per U.S. gal. was tested in two ways for the control of larvae of *Hypoderma lineatum* (Vill.) and *H. bovis* (Deg.) in the backs of cattle in South Dakota. Individual calves, with an average of 25 larvae each, received 9·6 g. actual toxicant, either in a dilute spray or as 100 ml. of an aqueous mixture containing 20 ml. of the concentrate, which was poured over their backs from a dipper; the former gave 80 and the latter 99 per cent. reduction of the larvae, as compared with untreated animals. The degree of depression of blood cholinesterase activity was moderate and almost identical in the two groups of treated animals, and there was no significant difference in weights. Treatment by the second method gave 96 and 98 per cent. reduction in larvae in two groups of 49 animals, and, in a more detailed test, similar treatment with 10, 20 and 40 ml. of the concentrate in 100 ml. gave 85–88, 98 and 100 per cent. reduction, respectively. No signs of toxicity were observed in any of the animals, but dairy cattle treated with 40, 100 and 250 ml. of the undiluted concentrate showed slight skin irritation.

Metcalf (R. L.), Fukuto (T. R.) & Winton (M. Y.). **Alkoxyphenyl N-methylcarbamates as insecticides.**—*J. econ. Ent.* **53** no. 5 pp. 828–832, 21 refs. Menasha, Wis., 1960.

The authors give a table showing the properties of 24 alkoxyphenyl N-methylcarbamates and the results of investigations in which their insecticidal and anticholinesterase effects were compared with those of Sevin and m-isopropylphenyl N-methylcarbamate. It was found that the last was extremely toxic to larvae of *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.), but only moderately so to *Musca domestica* L., and that Sevin was somewhat less active against *Culex* and of low toxicity to *Musca*. The o-ethoxy-, o-isopropoxy- and m-ethoxyphenyl N-methylcarbamates were surprisingly toxic to *M. domestica*, and the 2,5- and 3,5-dimethoxyphenyl compounds even more so, and better than malathion, but none was as active as the m-isopropylphenyl compound against *Culex*.

Tests on the correlation of structure and inhibition of fly-brain cholinesterase with insecticidal effect showed some very complex relationships. In general, the compounds with most anticholinesterase effect, such as the m-ethoxy-, o-n-propoxy-, o-isopropoxy-, 3,5-dimethoxy- and 3,4,5-trimethoxyphenyl N-methylcarbamates, were very toxic to insects, but tests on synergism showed that the rate of detoxication in the insect body varies greatly with the position and nature of the substituents and that toxicity is directly associated with this factor. Piperonyl butoxide was added to five of the carbamates in a synergist:insecticide ratio of 5:1 and showed marked synergistic effect on all of them in tests against *M. domestica* [*cf. R.A.E.*, B **48** 212–213]. The degree of synergism was inversely correlated with the innate toxicity of the compound, the effect of the weakest and strongest, 3,4-dimethoxy- and 3,5-dimethoxyphenyl N-methylcarbamates, respectively, being multiplied by 33 and 2·5. This result has important implications in judging the relation of structure to activity in carbamates. Though most of those studied showed a fairly narrow range of anticholinesterase effect and would therefore be expected to have reasonably comparable toxicities to *M. domestica*, the LD50's ranged from 11 to more than 500 µg. per g. body weight. There thus appears to be no pronounced correlation between enzyme-inhibition and toxicity until the latter is measured in the presence of a synergist. It seems likely that the synergist acts by inhibiting detoxication mechanisms, which are probably relatively non-specific esterase systems that degrade the toxic compounds before they reach the site of action.

It is reported in conclusion that 2-isopropoxy-5-methoxyphenyl N-methylcarbamate was recently prepared and found to be much more toxic to *M. domestica* than the 3,5-dimethoxyphenyl compound, the most effective of those dealt with in this paper.

Boyd jr. (N. R.) & Arthur (B. W.). **Biological degradation of O,O-diethyl O-naphthalimido phosphorothioate (Bayer 22408).**—*J. econ. Ent.* **53** no. 5 pp. 848–853, 3 graphs, 18 refs. Menasha, Wis., 1960.

In laboratory tests in which Bayer 22408 (O,O-diethyl O-naphthalimido phosphorothioate) labelled with ^{32}P was applied orally, dermally or subcutaneously to rats, topically to *Musca domestica* L., *Blattella germanica* (L.) and other insects [*cf. R.A.E.*, A **49** 414] and in sprays to cotton plants, the same group of metabolites, comprising the oxygen analogue (diethyl naphthalimido phosphate (Bayer 25820)), the ethyl phosphoric, diethyl phosphoric and O,O-diethyl phosphorothioic acids and at least three other compounds, was isolated from the three types of biological systems, but in very different proportions.

Rats degraded most of the Bayer 22408 rapidly to water-soluble phosphoric acids, which were eliminated primarily in the urine, but some escaped degradation and was eliminated intact in the faeces. The compound was stable in insects, and most of the absorbed material was recovered as administered, but the oxygen analogue was formed in small amounts by all insects and more readily by *M. domestica* and *B. germanica*, and unidentified fractions were recovered from some. When administered orally to rabbits at 25 mg. per kg., Bayer 22408 did not kill nymphs of *Amblyomma maculatum* Koch, or *Cimex lectularius* L. or adults of *Stomoxys calcitrans* (L.) that were allowed to take a blood-meal from them and did not appear to injure the rabbits, but at 50 mg. per kg. it was very toxic to the rabbits and did not kill *Cimex* or *Stomoxys*.

Barr (A. R.), Smith (T. A.) & Boreham (M. M.). **Light intensity and the attraction of mosquitoes to light traps.**—*J. econ. Ent.* **53** no. 5 pp. 876–880, 3 graphs, 8 refs. Menasha, Wis., 1960.

Tests were carried out in California to determine the effect of various factors on the efficiency of light-traps in collecting *Aëdes nigromaculis* (Ludl.), *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.), *C. tarsalis* Coq. and

C. peus Speiser. A device consisting of four New Jersey light-traps suspended from the arms of a rotary stand [*cf. R.A.E.*, B **48** 167], was used, and the following is based mainly on the authors' summary of the work. The numbers of mosquitos caught showed important differences when the device was stationary and the traps were within a few feet of each other, especially when mosquitos were present in large numbers, but these differences were eliminated when the device was rotating. There was no evidence that rotating traps caught fewer mosquitos than stationary traps. Significantly more mosquitos of each sex and each species were taken in lighted than in unlighted traps, except that similar numbers of females of *C. p. fatigans* were taken in both. The number of mosquitos in a trap appeared to be directly proportional to the light intensity, with the exception that females of *C. p. fatigans* seemed to be attracted to light on dark, but not on moonlit, nights to such an extent that unlighted traps probably give a better indication of the abundance of this mosquito than lighted ones. Mosquitos were not repelled by even the highest light intensities tested.

SUN (Yun-pei) & JOHNSON (E. R.). **Analysis of joint action of insecticides against house flies.**—*J. econ. Ent.* **53** no. 5 pp. 887–892, 14 refs. Menasha, Wis., 1960.

A simple method was developed for calculating the joint toxicity of mixtures of insecticides and especially of those in which each component is insecticidal at test concentrations. The following is substantially the authors' abstract. For the analysis of the joint action of two or more insecticides, the actual toxicity indices [*R.A.E.*, B **38** 186] of the components and their mixture are determined from dosage-mortality curves. The theoretical toxicity index of a mixture is the sum of toxicity indices calculated by multiplying the percentage of each component in the mixture by its respective toxicity index, and the joint toxicity or co-toxicity coefficient of a mixture is 100 times the actual toxicity index of the mixture divided by its theoretical toxicity index. When a coefficient of a mixture is near 100 it indicates similar action, and a coefficient significantly above 100 strongly indicates synergism; independent action should usually give a coefficient less than 100, but the toxicity of the mixture should be higher than that of either component; if it is significantly less than that of the strongest component, antagonism is indicated. In tests to determine the co-toxicity coefficients of 39 mixtures of insecticides, dieldrin, aldrin, α chlordane, β chlordane, endrin, isodrin, γ BHC (lindane), DDT, rotenone, methyl-parathion, nicotine, pyrethrins, sesamex and SD-3562 (dimethyl 1-dimethylcarbamoyl-1-propen-2-yl phosphate, here defined as 3-(dimethoxyphosphinyloxy)-N,N-dimethylcrotonamide) were used. Adults of *Musca domestica* L. were sprayed with kerosene solutions of mixtures containing 2–4 of these in a horizontal tunnel [*loc. cit.*]. Generally, chemically related compounds showed similar action, while unrelated compounds showed independent action. Sesamex showed a high synergistic effect with SD-3562, but was antagonistic with methyl-parathion.

SMITH (C. N.) & others. **Dimetilan baits, fly ribbons and cords for the control of house flies.**—*J. econ. Ent.* **53** no. 5 pp. 898–902. Menasha, Wis., 1960.

The following is based on the authors' abstract. In laboratory tests, Dimetilan (3-methyl-5-pyrazolyl dimethylcarbamate) incorporated into sugar baits gave complete and nearly complete control of females of *Musca domestica* L. from susceptible and malathion-resistant strains at concentrations of 0·1 and 0·05 per cent. toxicant, respectively. In dairy barns in central Florida, 1 per cent. Dimetilan baits gave effective control of house-flies with moderate to high resistance to organophosphates in one of two tests. In field tests in 1958–59, ribbons 2 m. long that were impregnated with sweet syrup and 1 g. Dimetilan per m. and cotton cords impregnated with 13·79 per cent. parathion and 3·54 per cent. diazinon (mixed) were installed at the rate of one ribbon or 30 ft. of cord per 100 sq. ft. of floor area and gave practical control of house-flies in pig parlours [*cf. R.A.E.*, B **49** 149] in Mississippi, but not in barns or poultry houses in Nebraska, Texas or Florida. In contact sprays applied in a wind tunnel, a 10:1 mixture of piperonyl butoxide and Dimetilan was 2·5 times as toxic to females of *M. domestica* from a susceptible colony as Dimetilan alone.

TARSHIS (I. B.). **Control of the snake mite** (*Ophionyssus natricis*), **other mites, and certain insects with the sorptive dust, SG 67.**—*J. econ. Ent.* **53** no. 5 pp. 903–908, 14 refs. Menasha, Wis., 1960.

As SG 67, which is composed of 95·3 per cent. silica aerogel with 4·7 per cent. ammonium fluosilicate impregnated in less than a continuous mono-molecular film on the internal surfaces of the finely divided compound, gave effective control of various mites and insects [*cf. R.A.E.*, B **48** 207] in preliminary laboratory tests, studies were carried out on its effectiveness against *Ophionyssus natricis* (Gerv.), which is a pest of reptiles in laboratories and zoological gardens. In preliminary field trials, good control of the mite was obtained on a gopher snake (*Pituophis catenifer annectens*) and an alligator lizard (*Gerrhonotus multicarinatus*) by placing the former in a receptacle containing 10 oz. SG 67 for one week and by dusting the latter with the compound. No ill effects were observed on the reptiles or on a mite-free ring-neck snake (*Diadophis amabilis*) that was submerged in about 1 oz. SG 67 for more than 18 hours. A single application of 7 oz. SG 67 to the inner framework and to the mixture of vermiculite and sand on the floor of each of four reptile cages 6 × 3 × 1½ ft. in size gave good control of mites in the cages and on their inhabitants, and no mites were observed during the next 16 months. During this period, control of infestations on 50 snakes and 50 lizards was obtained by housing the reptiles in the treated cages for varying periods. No adverse effects were noted. Similar results were obtained at a zoo.

SCHECHTER (M. S.), SULLIVAN (W. N.) & YEOMANS (A. H.). **Studies on fine-particle, coarse-particle, and concentrated aerosols.**—*J. econ. Ent.* **53** no. 5 pp. 908–914, 1 graph, 19 refs. Menasha, Wis., 1960.

The experiments described were undertaken to determine the effects of various physical factors and of the formulation used on the efficiency of liquefied-gas aerosols for the control of insects in aircraft. The toxicant was usually allethrin, most of the tests were carried out in rooms of 1,000 cu. ft. capacity, and the test insect was generally *Musca domestica* L. The following is based mainly on the authors' summary of the results. The important factor in effectiveness was the concentration of toxicant dispersed per unit volume of air. Allethrin aerosols consisting of fine particles of 2–5 μ mass median diameter were about as effective as those of coarse particles of 15–20 μ [*cf. R.A.E.*, B **38** 116]; aerosols having particles of 2 and 20 μ applied at a rate of 42 mg. per 1,000 cu. ft. killed 78 and 67 per cent., respectively, of house-flies exposed for 18 hours. After it was found that the amount of non-volatile substance in aerosol formulations is of little consequence so long as the spray droplets do not exceed the conventional aerosol size (15–20μ), concentrated aerosol formulations were prepared containing up to 10 per cent. allethrin with no other adjuvants, and these were found to be highly effective against susceptible and resistant house-flies.

MICKS (D. W.). **Susceptibility of mosquitoes to silica gel insecticides.**—*J. econ. Ent.* **53** no. 5 pp. 915–918, 1 fig., 2 refs. Menasha, Wis., 1960.

The following is based largely on the author's abstract. Females of laboratory-reared strains of *Anopheles quadrimaculatus* Say and *Culex pipiens fatigans* Wied. and susceptible and DDT-resistant strains of *Aëdes aegypti* (L.) were exposed for one hour to filter papers treated with silica gels, applied either by distributing them evenly with a camel's-hair brush or by spraying with an aqueous suspension that was allowed to dry. Drie-Die, a silica aerogel, applied at a rate as low as 50 mg. per sq. ft., caused 78–96 per cent. mortality of all the species when access to sugar solution after exposure was denied, but less than 26 per cent. mortality when access was allowed. It was equally effective against susceptible and DDT-resistant strains of *A. aegypti* but its effectiveness was reduced at 100 per cent. relative humidity. Aqueous suspensions were less than half as effective as the dust. Death of mosquitos was due partly to desiccation, and was frequently accompanied by the formation of exudates that appeared as spherical or hemispherical masses on the scutum, legs or wings. At dosages of 250–500 mg. per sq. ft. neither a dust nor an aqueous suspension of Silikil-D, a silica gel, showed appreciable effectiveness against *A. aegypti* at a relative humidity of 42 per cent., at which the respective percentages killed were 0–21 and 0–11, but were more effective at 95 per cent. relative humidity, at which mortality rose to 12–63 and 29–61.

MULLA (M. S.) & AXELROD (H.). **Efficiency of granulated insecticides influenced by solvents used for impregnation.**—*J. econ. Ent.* **53** no. 5 pp. 938–949, 10 figs., 13 refs. Menasha, Wis., 1960.

The following is taken mainly from the authors' abstract. Detailed studies were made of the effects of 44 petroleum solvents, with a wide range of chemical and physical properties, on the rate and magnitude of the release of the toxicant from attapulgite granules impregnated with 2 per cent. parathion, as used for the control of mosquito larvae. The solvents were used at a concentration of 10 per cent. of the weight of the finished formulation, small amounts of each granular formulation were dropped into water and the rate of release of the parathion was estimated by observing the mortality of fourth-instar larvae of *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) in samples of the treated water. The rate and magnitude of release for almost all solvents (aromatic compounds, paraffins and naphthenes) were inversely related to their flash point, minimum and maximum boiling points, distillation range and evaporation rate, and a simple formula is given for calculating a relative efficiency index from the flash point and boiling points, together with a list of solvents that would allow release of parathion at rates ranging from three to over 60 per cent. in 24 hours.

Drummond (R. O.), Moore (B.) & Wrich (M. J.). **Field tests with insecticides for control of lone star ticks on cattle.**—*J. econ. Ent.* **53** no. 5 pp. 953–955, 1 ref. Menasha, Wis., 1960.

Sprays of 11 compounds were tested on farms in Texas in 1958 and 1959 for their effectiveness in controlling *Amblyomma americanum* (L.) on cattle. One and (in brackets) two weeks after treatment, the percentage reductions in the numbers of ticks were 85 (19), 71 (17), 64 (22), 63 (40), 55 (0), 43 (0), 35 (0) and 23 (29), respectively, for 0·5 per cent. coumaphos (Co-Ral), Sevin, toxaphene, Bayer 22408 (O,O-diethyl O-naphthalimido phosphorothioate), malathion, trichlorphon (Dipterex), Ruelene (O-methyl O-4-tert.-butyl-2-chlorophenyl methylphosphoramidate) and dicapthon, 75 (25) for 0·15 per cent. Delnav (2,3,-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)), 55 (32) for 0·75 per cent. fenchlorphos (ronnel) and 20 (0) for 0·025 per cent. γ BHC (lindane).

Sullivan (W. N.), Yeomans (A. H.) & Schechter (M. S.). **The effectiveness of liquefied-gas-propelled concentrated allethrin aerosols and air-atomized Dibrom aerosols against normal and resistant house flies.**—*J. econ. Ent.* **53** no. 5 p. 956, 1 ref. Menasha, Wis., 1960.

As concentrated aerosols of allethrin were highly effective against houseflies (*Musca domestica* L.) of susceptible and resistant strains [*cf. R.A.E.*, B **49** 186], experiments were undertaken to determine whether the formulation could be further concentrated without loss in effectiveness and still produce a satisfactory aerosol. Flies from susceptible, resistant and mixed strains were exposed to liquefied-gas aerosols containing 10, 15 or 20 per cent. allethrin and air-atomised aerosols containing 2 per cent. w/v Dibrom (dimethyl 1,2-dibromo-2,2-dichloroethyl phosphate) for 30 minutes in a chamber of 1,000 cu. ft. capacity. There seemed to be no difference in effectiveness between the three concentrations of allethrin when equal amounts of active toxicant were used. Both allethrin and Dibrom aerosols gave almost complete mortality of susceptible flies, but Dibrom was the more effective against resistant flies; the percentage mortalities of the latter obtained in 24 hours were 77, 58 and 94 for 20 per cent. allethrin aerosols at 338, 561 and 963 mg. toxicant per 1,000 cu. ft. and 83, 96 and 99 for 2 per cent. Dibrom aerosols at 14, 28·4 and 53·5 mg.

Roberts (R. H.), Radeleff (R. D.) & Wheeler (H. G.). **Malathion residues in the tissues of sheep, goats, and hogs.**—*J. econ. Ent.* **53** no. 5 pp. 972–973, 7 refs. Menasha, Wis., 1960.

Malathion has been used successfully for the control of arthropod pests of livestock and experiments were carried out to determine the amount of malathion remaining in the tissues of pigs [*cf. R.A.E.*, B **47** 108], sheep and goats that had been treated with a 1 per cent. spray twice, at an interval of a week. Two goats, two sheep and a pig were sprayed with an emulsion and a second pig with a suspension. One of the goats and one of the sheep had been shorn and the others were in full fleece; a goat and a sheep were left untreated as controls. The animals were slaughtered a week after treatment, and analysis of tissue samples showed no malathion in the tissues of the pigs and only small amounts in those of the treated sheep and goats, except in the omental fat of the goats, which contained 3·20 parts malathion per million.

HATCH (C.). **Further trials with Trolene against warble fly larvae.**—*Irish vet. J.* **13** no. 10 pp. 193–197, 2 refs. Dublin [1959].

The following is substantially the author's summary. Two further trials were made to test the efficacy of fenchlorphos (Trolene) against *Hypoderma* larvae in cattle in the Irish Republic in 1958–59 when administed as a drench at the rate of 5 g. per 100 lb. body weight [*cf. R.A.E.*, B **49** 44]. It was found that a single dose caused a 100 per cent. reduction in the numbers of larvae that reached the backs of cattle when administered in early September, and 70–72 per cent. reduction when administered in mid-November.

McGREGOR (J. K.) & LORD (L. H.). **Clinical report—control of demodectic mange.**—*Vet. Med.* **54** pp. 308–310, 312, 1 fig., 4 refs. Chicago, Ill., 1959.

An account is given of the control of *Demodex canis* Leydig on six dogs by successive topical applications of a 50 per cent. fenchlorphos (Trolene) emulsion concentrate diluted with an equal amount of glycerine, either alone or with one or more oral applications of fenchlorphos in capsule form at the rate of 110 mg. per kg. body weight [*cf. R.A.E.*, B **48** 238].

GOODMAN (J. G.). **Effects of feeding boron to hens to prevent flies.**—*Progr. Rep. Ser. Ala agric. Exp. Sta.* no. 71, [2] pp. Auburn, Ala., 1958.

Tests were carried out in 1957–58 to determine the effects on the development of larvae of *Musca domestica* L. in the droppings of caged laying hens of feeding the latter on a diet containing Polybor 3 (disodium octaborate tetrahydrate) [*cf. R.A.E.*, B **48** 165]. It was found that the addition of 1–4 oz. Polybor per 100 lb. food completely or almost completely prevented fly emergence, but there was a decrease in feed intake and egg-production and an increase in the boron content of eggs and body tissues for the highest rate. In a further test, there was no reduction in the fertility of eggs from hens given Polybor at the rate of 4 oz. per 100 lb. food for 14 weeks, but the number of hatchable eggs was reduced when the treatment was continued for 22 weeks.

PAPERS NOTICED BY TITLE ONLY.

HAMILTON (E. W.) & DAHM (P. A.). **A versatile automatic microapplicator** [for the injection or topical application of insecticide solutions].—*J. econ. Ent.* **53** no. 5 pp. 853–856, 3 figs., 5 refs. Menasha, Wis., 1960. [See *R.A.E.*, A **49** 414.]

New cattle pest appears in east [*Musca autumnalis* Deg. in New Jersey and the north-eastern United States].—*N. J. Agric.* **41** no. 6 p. 15, 1 fig. New Brunswick, N. J., 1959.

IYENGAR (M. O. T.). **Summary data on filariasis in the South Pacific** [Islands including Tonga (*cf. R.A.E.*, B **44** 181–182), with data on *Wuchereria bancrofti* in mosquitos].—*Tech. Pap. S. Pacif. Comm.* no. 132, v + 92 pp., 1 fldg. map, 10½ pp. refs., multigraph. Noumea, 1960.

Smithburn (K. C.), Paterson (H. E.), Heymann (C. S.) & Winter (P. A. D.). **An agent related to Uganda S virus from man and mosquitoes in South Africa.**—*S. Afr. med. J.* **33** pp. 959–962, 7 refs. Cape Town, 1959.

A strain of virus was isolated in March 1956 in northern Natal from the blood of an African boy during an access of fever, and comparison of acute and convalescent sera from the donor showed that specific neutralising antibodies developed during convalescence and indicated that the virus was responsible for the fever. An apparently identical strain of virus was isolated from females of *Culex rubinotus* Theo. caught near Johannesburg early in 1958 in a locality in which cases of febrile illness of unknown aetiology were occurring. These two strains are very closely related to, but apparently not identical with, Uganda S virus. Considerable numbers of human sera from residents in the Tonga lowlands of northern Natal and various localities in Mozambique showed neutralising antibodies for the new virus. It was transmitted in the laboratory to baby mice by the bite of reared females of *C. univittatus* Theo., one of the dominant mosquitos in the coastal lowlands of Natal.

Trapido (H.), Rajagopalan (P. K.), Work (T. H.) & Varma (M. G. R.). **Kyasanur Forest disease. Part VIII. Isolation of Kyasanur Forest disease virus from naturally infected ticks of the genus** *Haemaphysalis.* —*Indian J. med. Res.* **47** no. 2 pp. 133–138, 9 refs. Kasauli, 1959.

A disease (designated Kyasanur Forest disease) that caused massive mortality among monkeys and considerable illness among the inhabitants of villages adjacent to Kyasanur Forest in Shimoga District of Mysore State, early in 1956 and again in January 1957, was found to be caused by a virus of the arthropod-borne type. The dead monkeys were in all cases either within or at the edge of evergreen tropical forest and affected persons were villagers living in close association with the forest. The conditions were thus reminiscent of those favouring jungle yellow fever [*cf. R.A.E.*, B **45** 10]. However, apart from one report of mortality among monkeys without associated human cases in November 1956, just after the end of the monsoon, the disease was prevalent in the dry season. This, with the smallness of the affected area and the slow spread of the disease, raised doubt as to whether the main vectors were mosquitos. Daylight searches on 3rd April in Kyasanur State Forest near the village of Barage, where the virus was almost certainly active, yielded fair numbers of *Culex vishnui* Theo. and *C. whitmorei* (Giles) from vegetation, but only a single female (*Aëdes albopictus* (Skuse)) was taken attacking man in three hours' collecting. The first collection of insects attracted to man between 6 p.m. and 6 a.m. yielded 49 mosquitos (*C. vishnui*, *C. whitmorei*, *Mansonia uniformis* (Theo.), *Anopheles leucosphyrus* Dön., *A. hyrcanus* (Pall.) and *C. bitaeniorhynchus* (Giles) and no other biting Diptera. Yet, as local residents are exposed to attack mainly in daylight hours, mosquitos did not appear to be likely vectors. Collections on succeeding days on the forest floor confirmed that day-time attacks were rare, and catching on platforms showed that there was no distinctive mosquito fauna in the canopy.

Collection of ticks and mites by dragging with cotton flannel squares was begun on 15th April and immediately showed larvae and nymphs of *Haemaphysalis* to be abundant. One adult male each of *H. formosensis* Neum., *H. spinigera* Neum. and *H. papuana* Thorell and 201 larvae and 589 nymphs of unidentified species were taken between 15th and 17th, as well as 93 larvae of *Ixodes* and 16 nymphs of *Amblyomma*. The nymphs of *Haemaphysalis* seemed to be of two types. Two collectors developed high fever on 17th April, and work in the forest was suspended. The virus was later isolated from their blood, and a third collector developed the disease several days later. Collection was resumed on 15th May after the virus had been shown to belong immunologically to the complex of Russian spring-summer encephalitis [**45** 52] and field personnel had been protected accordingly. Two strains of virus pathogenic to adult and infant mice were isolated from large pools of unengorged larvae and nymphs of *Haemaphysalis*, one collected on 15th April and one on 17th. Both types of nymphs were represented. From July to October 1957, 14 additional isolations were made from unengorged adults (12 from *H. spinigera* and one each from *H. turturis* Nuttall & Warburton and *H. papuana*). All the ticks were taken in Kyasanur Forest or forests adjacent to villages where deaths in monkeys and cases in man had occurred. There were no isolations from a large number of ticks tested from localities outside the epidemic area or from ticks of other genera. The work to date therefore suggests that ticks of the genus *Haemaphysalis*, particularly *H. spinigera*, are responsible for transmission.

Doby (J. M.), David (F.) & Rault (B.). **L'élevage, en laboratoire, de l'oeuf à l'adulte, de** *Simulium ornatum* **Meigen, 1818,** *S. aureum* **Fries, 1824,** *S. erythrocephalum* **de Geer, 1776,** *S. decorum* **Walker, 1848 (Diptères, Nématocères, Simuliidés). Observations biologiques concernant ces espèces.**—*Ann. Parasit. hum. comp.* **34** no. 5–6 pp. 676–693, 4 figs., 26 refs. Paris, 1959.

Techniques by which earlier workers reared Simuliids from egg to adult in the laboratory are reviewed, and an apparatus in which adults of *Simulium ornatum* Mg., *S. aureum* Fries, *S. erythrocephalum* (Deg.) and *S. decorum* Wlk. were easily reared from eggs collected in north-western France between 1956 and 1958 is described. It consists of a small vertical glass cylinder divided vertically into halves by a sheet of glass of the same width as the container and raised a few centimetres from the bottom of it. Compressed air, introduced into one half through a tube bent at the end, causes the water to circulate upwards in one half and downwards in the other. Emerging adults can be caught in muslin pockets covering the container. The apparatus is easy to clean, and observation of the Simuliids is easy. Data are given on the seasons at which eggs were collected, on the duration of the larval stage in each species and on the number of generations in the first three.

Jamnback (H.) & Wall (W. J.). **The common salt-marsh Tabanidae of Long Island, New York.**—*Bull. N. Y. St. Mus.* no. 375, 77 pp., 27 figs., 4½ pp. refs. Albany, N. Y., 1959.

This account of the Tabanids that breed in the salt-marshes of Long Island is based mainly on a study made in 1954–57 and includes descriptions of, and keys to, the immature stages of five species, with collection and rearing data and observations on the bionomics of the commonest. *Tabanus nigrovittatus* Macq. was found to be the most abundant and annoying species. *T. lineola* F., *Chrysops atlantica* Pechuman and *C. fuliginosa* Wied. were also commonly collected. Studies on control indicated that dieldrin in a granular formulation scattered over the marshes from a helicopter at about 0·3 lb. toxicant per acre greatly reduced larval populations of *Tabanus* [*cf. R.A.E.*, B **46** 136]; in some instances, this reduction was reflected in reduced adult populations within the treated area. Observations in 1957 showed little re-population of areas treated in 1956.

Maillot (L.). **Infection naturelle de** *Glossina fuscipes quanzensis* **Pires par** *Trypanosoma cazalboui-vivax.—Bull. Inst. centrafr.* (N.S.) no. 17–18 pp. 71–86, 2 graphs, 23 refs. Brazzaville, 1959.

The following is based on the author's summary and conclusions. Observations on the natural infection of *Glossina fuscipes quanzensis* Pires with trypanosomes, made on the island of M'Bamou near Brazzaville, in the Congo, from February to October over a period of several years, showed a high rate of infection, predominantly with *Trypanosoma vivax.* The highest monthly rates (14, 13 and 13 per cent.) occurred in February, May and September, when temperature and saturation deficit are fairly high, and the lowest (5 and 4 per cent.) in March and April when humidity and temperature are high and light is maximal. In the colder months of June–August, rates were 8–11 per cent.

Ruffinelli (A.) & Carbonell (C. S.). **Segunda lista de insectos y otros artrópodos de importancia económica en el Uruguay.** [Second list of insects and other arthropods of economic importance in Uruguay.]—*Rev. Asoc. Ingen. agrón.* no. 94 (1953) pp. 33–82, 60 refs. Montevideo, 1954.

This briefly annotated, systematic list of over 590 arthropods of economic importance in Uruguay includes more than 560 insects and arachnids that are of agricultural, medical or veterinary importance, or are troublesome in houses, or beneficial. A similar list of some 35 other invertebrates is given in an appendix, together with alphabetical lists of food-plants and host animals.

Bigley (W. S.) & Plapp jr. (F. W.). **Cholinesterase and ali-esterase activity in organophosphorus-susceptible and -resistant house flies.**—*Ann. ent. Soc. Amer.* **53** no. 3 pp. 360–364, 7 graphs, 15 refs. College Park, Md., 1960.

The following is virtually the authors' abstract. Cholinesterase and aliphatic esterase (aliesterase [*cf. R.A.E.*, B **49** 76, etc.]) activities were measured colorimetrically in organophosphorus-susceptible and -resistant strains of house-flies (*Musca domestica* L.), with acetylcholine and methyl-n-butyrate as substrates. The effects of time and enzyme concentration on the hydrolysis of the substrates were determined. The specificity of head and body breis in hydrolysing both substrates was measured, and distinct differences were shown in levels of esterase activity between the two body regions. Levels of cholinesterase activity were found to be nearly identical in susceptible and resistant flies, but aliphatic esterase activity was much lower in two resistant strains than in the susceptible colony, indicating a possible relationship between this esterase and resistance. Aliesterase was four times as susceptible as cholinesterase to inhibition by parathion and five times as susceptible to inhibition by paraoxon. With malathion, cholinesterase was twice as susceptible to inhibition as aliesterase.

Mulla (M. S.), Dorner (R. W.), Georghiou (G. P.) & Garber (M. J.). **Olfactometer and procedure for testing baits and chemical attractants against** *Hippelates* **eye gnats.**—*Ann. ent. Soc. Amer.* **53** no. 4 pp. 529–537, 3 figs., 6 refs. College Park, Md., 1960.

The following is based mainly on the authors' summary. A simple new trap and olfactometer designed for evaluating baits and chemical attractants for adults of *Hippelates* spp. in the open in California are described. The trap was based on the phototropic and geotropic responses and olfactory behaviour of the adults and consists essentially of an inverted glass funnel with a collecting vial fitted to the stem, which is cut off close to the base. The funnel stands on a dish containing the attractant under test. The olfactometer consists of a series of such traps arranged round the periphery of a turntable, which is operated electrically. They are fitted into holes covered on the underside with a screen, through which the insects pass on their way into the traps.

Various factors, including the level to which the funnel was illuminated (which was controlled by dipping in black paint) and the depth of the bait dishes, influenced efficiency, the catch increasing as the lighting level was raised and as shallower dishes with greater surface areas were used. The presence of an insecticide in the collecting vial was advantageous, and malathion, parathion, dicapthon, trichlorphon (Dylox) and fenchlorphos (Korlan) all increased the catches. No great differences in catch were observed when 16-mesh window screen or 8-mesh hardware cloth was used as the trap support in open shade, but the catches were greater for the coarser-mesh screen in the open sun.

Clifford (P. A.), Bassen (J. L.) & Mills (P. A.). **Chlorinated organic pesticide residues in fluid milk.**—*Publ. Hlth Rep.* **74** no. 12 pp. 1109–1114, 5 refs. Washington, D.C., 1959.

The following is taken from the authors' summary. In a survey in August-November 1958, 936 samples of raw milk from 48 dairies in 16 metropolitan areas in all parts of the United States were examined for the presence of chlorinated insecticides by a paper chromatographic method, and residues of 0·1 part per million or more, mainly of DDT, were found in 23 of them [*cf. R.A.E.*, B **47** 191]. Further examination of 168 of the samples by paper chromatography showed significant residues in five. The 168 samples were also analysed by bioassay with house-flies [*Musca domestica* L.], and toxic reactions were caused by 33 or 54 per cent. of the samples according to the technique used. Corresponding significant mortalities (death of more than 10 per cent. of 100 flies) were 15·5 and 39·3 per cent., respectively. The difference in results obtained by chromatography and bioassay is attributed to the reflection by bioassay of the sum of all residues toxic to the fly and the extreme sensitivity of house-flies to certain insecticides. Contamination of one sample of milk containing more than 0·1 p.p.m. toxic residue was found to be attributable to feeding on DDT-contaminated maize silage and of two others to careless spraying of barns with a concentrated solution of DDT.

Bachmann (F.). **Über die insektizide Wirkung von DDVP (O,O-Dimethyl-2,2-dichlorvinylphosphat).** [On the insecticidal effect of dichlorvos.]—*Anz. Schädlingsk.* **33** pt. 3 pp. 41–44, 3 graphs, 17 refs. Berlin, 1960. (With a summary in English.)

In tests of its insecticidal effectiveness [*cf. R.A.E.*, A **49** 457], dichlorvos (DDVP) proved more toxic than diazinon, γBHC (lindane), aldrin, parathion or DDT and much more rapid in action than DDT. Thus, the approximate LD50's on topical application were 0·005 μg. for *Musca domestica* L. and 0·02 μg. for *Calliphora vicina* R.-D. (*erythrocephala*

(Mg.)), and complete mortality of *M. domestica* was given in 11½ and 14–18 minutes in a closed chamber in which dichlorvos was released as an aerosol at 2·3 and 1·3 mg. per cu.m., respectively.

Harris jr. (E. D.), Genung (W. G.) & Haines (C. E.). **Cattle grub control with Bayer 21/199 in the Everglades.**—*Florida Ent.* **42** no. 4 pp. 155–157, 3 graphs, 1 ref. Gainesville, Fla., 1959.

Observations in the Everglades region of Florida in which cattle were sprayed with a 0·5 per cent. wettable-powder suspension of coumaphos (Bayer 21/199) for the control of *Hypoderma lineatum* (Vill.) in June, September or both months showed that a single treatment in June was sufficient to control the current low level of infestation.

LaBrecque (G. C.) & Wilson (H. G.). **Laboratory tests with sixty-five compounds as repellents against house flies.**—*Florida Ent.* **42** no. 4 pp. 175–177. Gainesville, Fla., 1959.

The results are given of tests at Orlando, Florida, in which 65 chemicals, lists of which are given, were investigated as vapour or contact repellents against house-flies (*Musca domestica* L.). The method is described. The work showed that 28 compounds remained effective for two or more days; di-n-octylamine, n-propyl n-octyl sulphoxide and 3-chloropropyl n-octyl sulphoxide were effective for more than 90 days, allyl n-octyl sulphoxide and N-amyl-2,3-norcamphanedicarboximide for 30 days and N-(n-pentyl) succinamide, N-n-heptylphthalimide and N-sec.-pentylphthalimide for 14 days.

Teskey (H. J.). **A review of the life-history and habits of** *Musca autumnalis* **DeGeer (Diptera: Muscidae).**—*Canad. Ent.* **92** no. 5 pp. 360–367, 43 refs. Ottawa, 1960.

Musca autumnalis Deg. has increased rapidly in importance as a pest of cattle in North America since its recent discovery in Nova Scotia [*cf. R.A.E.*, B **43** 55], having been reported also from Prince Edward Island, New Brunswick, Quebec and Ontario in Canada and from New York [*loc. cit.*], Illinois [**49** 121], Ohio, Indiana, Virginia [**49** 13], West Virginia, Vermont, New Hampshire, Delaware, New Jersey [**49** 188], Massachusetts, Pennsylvania, Michigan, Minnesota and Iowa in the United States. This paper contains descriptions of all stages, characters separating the adults from those of *M. domestica* L. and an account of the bionomics of *M. autumnalis* based on the literature and the author's observations. The following is based almost entirely on his summary. The adult is a facultative blood-sucker, mainly of cattle, feeding on the blood exuding from wounds made by biting flies [*cf.* **31** 175]. It also feeds on nectar, secretions from animals and dung liquids [*cf.* **32** 118]. In addition to the annoyance caused to cattle, the flies are suspected vectors of certain diseases [*cf.* **25** 155], but no proof of this has been presented. In Ontario, the fly is present in the field throughout the summer, entering buildings only to hibernate. The eggs are laid singly in fresh cattle dung dropped in the pasture. The larvae develop rapidly through three instars and pupate near the edge of the droppings or in the soil close by. In south-western Ontario, development from egg to adult lasts about two weeks.

McKiel (J. A.), Hall (R. R.) & Cousineau (G.). **Distribution of** *Xenopsylla cheopis* **(Rothsch.) (Siphonaptera: Pulicidae) in Canada.**—*Canad. Ent.* **92** no. 6 pp. 428–429, 5 refs. Ottawa, 1960.

Xenopsylla cheopis (Roths.) was hitherto known in Canada only from two places in British Columbia [*cf. R.A.E.*, B **29** 158] and from Toronto, Ontario, and Halifax, Nova Scotia. In July 1958, six males and 14 females were collected from rats (*Rattus norvegicus*) at a garbage dump at Cornwall, Ontario, and, between 18th June and 14th July 1959, three females were found on *R. norvegicus* trapped in a basement in Montreal, Quebec.

Wallace (F. G.) & Johnson (A.). **The infectivity of old cultured strains of mosquito flagellates.**—*J. Insect Path.* **3** no. 1 pp. 75–80, 2 figs., 13 refs. New York, N.Y., 1961.

The following is mainly the authors' summary. Four strains of *Crithidia fasciculata* that had been maintained in culture for 44, 34, 18 and 2 years, respectively, and a strain of *Blastocrithidia* (*Herpetomonas*) *culicis* that had been maintained for eight years caused heavy infections in adults of *Aëdes aegypti* (L.) allowed to feed on them in the laboratory. It is noted that trypanosomes lose their infectivity for the insect host when cultured or maintained in the laboratory by direct transfer from host to host without the insect vector [*R.A.E.*, B **49** 113, etc.].

Cockbain (A. J.) & Hastie (A. C.). **Susceptibility of the bed bug,** *Cimex lectularius* **Linnaeus, to** *Aspergillus flavus* **Link.**—*J. Insect Path.* **3** no. 1 pp. 95–97, 1 fig. New York, N.Y., 1961.

A culture of *Cimex lectularius* L. at Rothamsted was attacked by *Aspergillus flavus* and was destroyed in 18 days. When newly moulted second-instar nymphs and adults were dusted or sprayed with spores of the fungus, their length of life was reduced in five of six tests. No external signs of infection developed in those kept at 30°C. [86°F.] and 50 per cent. relative humidity or at 20°C. [68°F.] and 90 per cent. relative humidity, but the fungus appeared on the surface of most of the infected bugs at 30°C. and 90 per cent. relative humidity.

Khelevin (N. V.). **The seasonal character of hatching and the appearance of embryonic diapause in** *Aëdes caspius dorsalis* **Mg. (Diptera, Culicidae).** [*In Russian.*]—*Rev. Ent. URSS* **38** pt. 2 pp. 394–407, 8 refs. Moscow, 1959. (With a summary in English.)

It was observed in the European part of the Soviet Union in 1941 that eggs of *Aëdes dorsalis* (Mg.) laid in July hatched immediately after flooding, whereas those laid in September did not hatch until the following spring, despite earlier flooding. Investigations on the cause were begun in the succeeding year, and the following is based on the author's summary of the findings. The eggs of *A. dorsalis* undergo a summer and an autumn diapause. The summer diapause is an adaptation to the seasonal drying up of shallow waters, and the autumn one an adaptation for survival during the adverse conditions of winter. As a result mainly of the autumn diapause, hatching is distinctly seasonal. The termination of the diapause in autumn eggs is hastened by high (summer) temperatures, and was also accelerated by exposure to temperatures below freezing-point. In most eggs, the diapause is terminated in January or February, and winter mortality is usually low. Unfavourable conditions lead to a prolongation of the diapause, and some diapause eggs remained viable for up to 15 months, after which exposure to low temperature under natural conditions led to resumption of development and the hatching of normal larvae. In nature, the hatching of such long-diapause eggs occurs in their third warm season.

NAGIEV (G. M.). **On the ecology and the summer and autumn phenology of the common malaria mosquito** *Anopheles maculipennis* **Mg. var.** *subalpinus* **H.L. in the south-east of the maritime part of Azerbaijan.** [*In Russian.*]—*Rev. Ent. URSS* **38** pt. 2 pp. 408–423, 3 graphs, 17 refs. Moscow, 1959. (With a summary in English.)

The following is based on the author's summary. *Anopheles maculipennis melanoon* Hackett (*A. m. subalpinus* Hackett & Lewis) is an important vector of malaria in the maritime south-eastern part of Soviet Azerbaijan. Investigations were made on its ecology near Lenkoran in 1956, and the results agreed in the main with earlier findings for the region. Observations on the duration of the gonotrophic cycle showed that the relative rates of maturation of the ovaries corresponded to norm II and norm III of Beklemishev [*R.A.E.*, B **23** 111]. The seasonal variations of abundance were of the southern type, characterised by a two-peak curve, with an intervening depression during the period of highest summer temperatures. However, in some parts of the area (such as the rice-growing districts), a one-peak curve was observed. The overwintered adults and those of the first generation were of negligible epidemiological significance, both on account of their small numbers and because daily mean temperatures of over 15°C. [59°F.], which are required for the development of the malaria parasite in them, are not reached until May; when May is colder than usual, most of the mosquitos die before it is completed, and, in such years, transmission is uncommon before June. Females with a developing fat-body appear at the beginning of August, but do not become numerous until the second third of September. Blood-feeding is necessary for the autumn accumulations of fat, and this considerably prolongs the period of possible malaria transmission. Some transmission is probably effected in buildings during autumn and winter by hibernating females, in which the period of blood-feeding is protracted as a result of gonotrophic discordance, but this lacks confirmation. Control measures are best directed to preventing population increase in spring and summer.

YAKUBA (V. N.). **On the migrations of black-fly larvae (Diptera, Simuliidae).** [*In Russian.*]—*Rev. Ent. URSS* **38** pt. 2 pp. 424–434, 1 graph, 10 refs. Moscow, 1959. (With a summary in English.)

Migrations of Simuliid larvae for more or less considerable distances along streams occur both actively and passively as a result of carriage by flowing water. Many of the migratory larvae are carried far downstream and perish, so that the numbers of adults emerging are reduced. Examples of this are cited from observations on several species in the Angara river and its tributaries, in eastern Siberia, in 1955. The migratory activity increases with the age of the larvae and appeared to be stimulated by a rapid rise in water level.

Greenberg (B.). **Persistence of bacteria in the developmental stages of the housefly. III. Quantitative distribution in prepupae and pupae.**—*Amer. J. trop. Med. Hyg.* **8** no. 6 pp. 613–617, 1 fig., 9 refs. Baltimore, Md., 1959. **IV. Infectivity of the newly emerged adult.**—*T.c.* pp. 618–622, 3 figs., 21 refs.

The following paragraphs are based mainly on the author's summaries of these two papers, respectively.

As smaller numbers of the bacteria that occur normally in *Musca domestica* L. were found in the prepupae and newly emerged adults than in other stages [*R.A.E.*, B **49** 175], studies were made on the factors responsible for their reduction in the prepupa and on their quantitative distribution in it and the pupa. Observations on starved third-instar larvae indicated that the reduction of the number of bacteria in the prepupae, to 10 per cent. of that in full-fed larvae results from a cessation of feeding by the third-instar larvae and from continued elimination from the gut of the prepupae. As the haemolymph, fat and tracheae of most full-fed larvae and prepupae are sterile, it is safe to assume that the gut wall of the larvae is an effective barrier to routine systemic invasion by the bacteria from the gut. The hind-gut of the prepupa typically harbours more bacteria than the mid-gut. Dissections of pupae indicated that the intestinal flora of the prepupa is transferred through the shedding of the cuticular lining of the gut, to the inner surface of the puparium, the moulting membrane, and the surface of the pupa, the gut of which retains very few organisms.

In a study of the quantitative distribution of the bacteria in the teneral adult, very few were found in the excreta and meconium of flies reared in a medium containing *Shigella flexneri*, *Salmonella enteritidis*, *S. typhi*, or a multiple saprophytic flora, or in the excreta of flies reared in a naturally contaminated medium (CSMA) and maintained aseptically for two days. Dissection of the hind- and most of the mid-gut of teneral adults so reared showed very few, and the numbers recovered from the surface of such flies were generally less than 50, though somewhat more were retained internally.

Scherer (W. F.) & Buescher (E. L.). **Ecologic studies of Japanese encephalitis virus in Japan. I. Introduction.**—*Amer. J. trop. Med. Hyg.* **8** no. 6 pp. 644–650, 4 figs., 10 refs. Baltimore, Md., 1959.

Buescher (E. L.) & others. **II. Mosquito infection.**—*T.c.* pp. 651–664, 7 figs., 28 refs.

Scherer (W. F.), Buescher (E. L.), Flemings (M. B.), Noguchi (A.) & Scanlon (J.). **III. Mosquito factors. Zootropism and vertical flight of** *Culex tritaeniorhynchus* **with observations on variations in collections from animal-baited traps in different habitats.**—*T.c.* pp. 665–677, 10 figs., 16 refs.

Buescher (E. L.) & others. **IV. Avian infection.**—*T.c.* pp. 678–688, 7 figs., 18 refs.

Scherer (W. F.), Buescher (E. L.) & McClure (H. E.). **V. Avian factors.**—*T.c.* pp. 689–697, 3 figs., 11 refs.

Scherer (W. F.), Moyer (J. T.), Izumi (T.), Gresser (I.) & McCown (J.). **VI. Swine infection.**—*T.c.* pp. 698–706, 4 figs., 13 refs.

Scherer (W. F.), Kitaoka (M.), Okuno (T.) & Ogata (T.). **VII. Human infection.**—*T.c.* pp. 707–715, 1 graph, 12 refs.

Scherer (W. F.), Buescher (E. L.), Southam (C. M.), Flemings (M. B.) & Noguchi (A.). **VIII. Survey for infection of wild rodents.**—*T.c.* pp. 716–718, 9 refs.

Buescher (E. L.) & Scherer (W. F.). **IX. Epidemiologic correlations and conclusions.**—*T.c.* pp. 719–722, 1 graph, 4 refs.

Epidemics of Japanese [B] encephalitis occur annually in Japan in August and September, and the ecology of the virus was studied at several places near Tokyo in 1952–57. In the introduction to this series of papers, details are given of the topography and population density of Japan as a whole and of the areas in which the investigations were made, the development of the work is outlined and the selection of insect vectors and vertebrate hosts to be studied is discussed.

The following paragraph is taken mainly from the authors' summaries of the second, fourth and sixth papers. The investigations on mosquitos showed that *Culex tritaeniorhynchus* Giles was the only species consistently infected with the virus in the field [*cf. R.A.E.*, B **40** 163]; the only other species found infected was *C. pipiens* L., which yielded two of the 300 virus strains isolated. Infection of *C. tritaeniorhynchus* was a regular summer phenomenon, limited to the period from late June to early October, and increased after the numbers of the mosquito had reached their peak. The investigations, together with studies of the infection of the birds and pigs of the area, showed that there was no direct chronological relation between the peaks of vector populations and epidemics or epizootics, but infection of black-crowned night herons (*Nycticorax nycticorax*), egrets (*Egretta* spp.) and pigs, as demonstrated by the recovery of the virus or by the appearance of antibodies, was related directly to the time when maximum density of infected mosquitos occurred in a specific area. Viraemia in the Ardeids and pigs was of sufficient titre and duration to infect females of *C. tritaeniorhynchus* in the laboratory [**48** 226], but no clear-cut evidence of infection in other birds (except cormorants) was obtained, and although antibodies were found in them, their relative efficiency for disseminating the virus is not known. Pigs, of which 98–100 per cent. on farms and in mosquito traps near Tokyo were found infected in August of 1956 and 1957, are regarded as a major natural source of the virus for *C. tritaeniorhynchus*, which showed a strong propensity to bite them in nature.

Investigations described in the third paper showed that, at a heronry and a neighbouring village in 1953, the number of females of *C. tritaeniorhynchus* that entered traps containing *N. nycticorax* was 3–15 times the number that entered traps containing egrets or fowls; other wild birds failed to attract significant numbers. In 1956, in one urban and two rural districts, *C. tritaeniorhynchus* was more attracted to pigs than to *Nycticorax* or man. At one heronry, *C. tritaeniorhynchus* was found in traps at heights of up to 50 ft. [**48** 166]. The attraction of the traps persisted for 1–3 days after removal of the bait. *C. pipiens* frequently entered traps baited with all species of birds, and was attracted to those with *Nycticorax* more than to those with pigs, while *Anopheles hyrcanus sinensis* Wied. was found in significant numbers only in the traps with pigs in rural areas, and other species of mosquitos were caught only in very small numbers. *C. pipiens* frequently bites birds and has been shown to transmit the virus in the laboratory [**40** 163]; its low rate of infection in the field is possibly due to its requiring a larger amount of the virus in ingested blood than does *C. tritaeniorhynchus* and more than is present in the blood of the Ardeids. Investigations on the behaviour, bionomics and population dynamics of these birds are described in the fifth paper. Migration and dispersal in August–November is probably a means by which the virus is carried beyond Ardeid colonies.

In the seventh paper, clinically apparent encephalitis is reported to have occurred annually in August and September from 1948 to 1956 and inapparent infection to have been found in June–November 1956 in 5 per cent. of 404 children aged 6–12 years in two areas where studies were made of the infection in mosquitos, birds and pigs. As the human population is large, this percentage represents a great number of infected individuals, but man's contribution to the infection of the mosquito vectors is considered insignificant in comparison with that of pigs and birds, because he is bitten so much less frequently. A report is given in the eighth paper of tests in urban and rural districts in 1953–57 that failed to provide any evidence of more than infrequent infection of wild rodents, which, it is suggested, are not bitten often by *C. tritaeniorhynchus*. In the last paper, the results of the investigations are discussed and correlated, and their implications for the control of the disease are considered.

Jenkins (A. A.) & Donath (R.). **The 1958 encephalitis outbreak in northern Utah. 1. Human aspects.**—*Mosq. News* **19** no. 4 pp. 221–222. Albany, N.Y., 1959.

Thomas (L. A.) & Smith (J. V.). **2. Infection rates in birds, mammals, and mosquitoes.**—*T.c.* pp. 223–226, 1 map.

Rees (D. M.), Ogden (L. J.), Collett (G. C.) & Graham (J. E.). **3. Mosquito populations in relation to the outbreak.**—*T.c.* pp. 227–231, 3 graphs, 1 ref.

The first of these papers on an outbreak of western equine encephalitis in northern Utah in the summer and autumn of 1958 is concerned with the human aspects, and the second with the prevalence of the infection in mosquitos and its incidence in birds, mammals and man. The virus was isolated from human tissues and from *Culex tarsalis* Coq., which was the only one of three species of mosquitos collected locally that was found to be infected, and in which only a very low rate of infection was indicated. The highest rates of infection in both mosquitos and chickens occurred in the centre of the human outbreak area, but the sera of the few wild birds examined did not show evidence of infection.

The following is substantially the authors' summary of the third paper. Collections of adults and larvae showed populations of *C. tarsalis* to have been much greater in 1958 than in 1956 or 1957. In 1958, there was an unusually warm and wet winter and spring, followed by a hot, dry summer with an abundance of water for irrigation.

Loomis (E. C.) & Sherman (E. J.). **Comparison of artificial shelters and light traps for measurement of** *Culex tarsalis* **and** *Anopheles freeborni* **populations.**—*Mosq. News* **19** no. 4 pp. 232–237, 1 graph, 13 refs. Albany, N.Y., 1959.

Collections of *Culex tarsalis* Coq. and *Anopheles freeborni* Aitken in cubical red boxes [*R.A.E.*, B **31** 218] placed in various localities in the Sacramento Valley of California, all except two of which were rural, were compared with those obtained with a light-trap sited in an urban locality, in the summers of 1955 and 1956. The following is based on the authors' summary of the results. The boxes showed similar seasonal fluctuations in populations, the catches being more consistent for *A. freeborni* than for *C. tarsalis*, and the results agreed generally with those given by the light-trap. *C. tarsalis* was taken in about equal numbers by both methods, but larger numbers of *A. freeborni* were taken from the box.

Fehn (C. F.), Carmichael (G. T.), Elmore jr. (C. M.) & Taylor (J. W.). **Operational experiences with paris green pellets in mosquito control.**—*Mosq. News* **19** no. 4 pp. 238–243, 1 fig., 8 refs. Albany, N.Y., 1959.

Field tests in Georgia showed that complete control of larvae of *Aëdes taeniorhynchus* (Wied.), *A. sollicitans* (Wlk.), *Psorophora confinnis* (Lynch Arrib.) and *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) was usually obtained when 15 per cent. paris green, formulated with an adhesive containing oil and an emulsifier on vermiculite pellets, was applied by hand to salt-marshes at the rate of 0·6 lb. toxicant per acre. Such pellets float in the water for several hours, thus permitting application rates to be checked. The paris green is freed rapidly and most of it drifts slowly down through the water, though some remains floating. The conclusions from one year's work, in which the average application rate was 1·5 lb. toxicant per acre, were that the pellets must be applied against second-, third- and fourth-instar larvae, since they had little, if any, pre-flood or residual effect and were not effective against first-instar larvae or pupae, and that application by hand was better than using mechanical distributors, which gave too uneven a distribution and threw back too much material on to the operators, or were too slow. Several of the men applying the pellets developed skin rashes, but no deleterious effects were noticed in livestock feeding in treated fields. In limited tests, a power duster applied the pellets successfully in swaths up to 100 ft. wide, and satisfactory distribution, with a swath width of 50 ft., was obtained from aircraft.

Chapman (H. C.). **Overwintering larval populations of** *Culex erythrothorax* **in Nevada.**—*Mosq. News* **19** no. 4 pp. 244–246, 7 refs. Albany, N.Y., 1959.

Culex erythrothorax Dyar was found in sun-lit pools containing *Scirpus* spp. in three counties in Nevada, and larvae were collected from October 1958 to February 1959 in one area and from January to April or May 1959 in the other two. Pupae were absent from early November to late March, indicating that this species overwinters in the larval stage, but a few biting adults were present in one area in November, though no egg-rafts were found, which suggests that a small proportion of the population overwinters as adult females. As this species was not found in July–September, the females possibly aestivate.

Mathis (W.), Schoof (H. F.) & Fay (R. W.). **Method for the field determination of susceptibility levels of adult mosquitoes.**—*Mosq. News* **19** no. 4 pp. 247–255, 5 figs., 2 refs. Albany, N.Y., 1959.

The authors describe and illustrate the use of a portable outfit developed as a result of studies begun in 1956 for the field evaluation of the level of susceptibility of local mosquito populations to DDT and dieldrin by a method incorporating the more important features of existing techniques [*cf. R.A.E.*, B **41** 156]. Filter papers bearing deposits of six concentrations of dieldrin from 0·05 to 1·6 per cent. and five of DDT from 0·25 to 4 per cent. in Risella oil applied at 3·6 mg. per sq. cm. are included, together with papers treated with oil only. Mosquitos are collected by means of aspirators and exposed to the papers in tubes, normally for one hour, after which they are transferred to fresh tubes and observed for mortality 24 hours later. Tests of the variability of the impregnated filter papers showed that preparation by a single commercial source was the best assurance of uniformity, that each paper could be used 20 times, and that storage for a year at 80°F. did not impair effectiveness, though two minutes at 115°F. did. In the application of the technique for the determination of resistance, the susceptibility of a given species to various concentrations of DDT or dieldrin is established by testing samples of populations from several places in the area. Subsequent routine tests can then be made, at the lowest concentration found to give complete mortality, to determine any change in susceptibility. Since the method does not reflect variations in the behaviour of insects in response to the insecticide, but merely their ability to survive contact with test deposits for a specific time under certain conditions, it should not be used to compare the field effectiveness of different insecticides, but is essentially designed to detect the presence of physiological resistance. Outfits similar to those described were being distributed by the World Health Organisation.

Burgess (L.). **Techniques to give better hatches of the eggs of** *Aedes aegypti* (**L.**) (**Diptera: Culicidae**).—*Mosq. News* **19** no. 4 pp. 256–259, 2 graphs, 9 refs. Albany, N.Y., 1959.

Although the eggs of *Aëdes aegypti* (L.) have been found to hatch well in distilled water [*cf. R.A.E.*, B **34** 24], those of a laboratory strain in Ontario hatched very poorly, and the effectiveness of deoxygenating the water in stimulating hatching [*cf.* **29** 164] was therefore investigated. The following are substantially the author's conclusions from this work and from studies of the effect of humidity on the viability of stored eggs. Immersion in distilled water containing less than 1–1·9 parts per million of dissolved oxygen was shown to be very effective, 52–86 per cent. of the eggs hatching, as compared with 0–38 per cent. in water with the normal oxygen content of 7–8 p.p.m. Increasing the humidity at which the eggs were stored increased and prolonged their viability and caused them to hatch more rapidly in deoxygenated water. About three times as many eggs hatched in reagent bottles that exposed little of the surface of the deoxygenated water to the air as hatched in open pans.

Loomis (E. C.). **Selective response of** *Aedes nigromaculis* (**Ludlow**) **to the Minnesota light trap.**—*Mosq. News* **19** no. 4 pp. 260–263, 1 fig., 5 refs. Albany, N.Y., 1959.

Tests in California in 1958 indicated that the pattern of lighting in the Minnesota light-trap [*cf. R.A.E.*, A **46** 223] is more selective for *Aëdes nigromaculis* (Ludl.) than that in the American Model suction light-trap [*cf.* B **48** 125, etc.], although it catches smaller numbers of mosquitos; the latter illuminates a small circle on the ground beneath the trap whereas the former projects a wide horizontal beam of light. The numbers caught by the Minnesota trap were increased by increasing the intensity of the beam.

Rosay (B.). **Expansion of eggs of** *Culex tarsalis* **Coquillett and** *Aedes nigromaculis* (**Ludlow**) (**Diptera : Culicidae**).—*Mosq. News* **19** no. 4 pp. 270–273, 3 graphs, 8 refs. Albany, N.Y., 1959.

Since absorption of water by arthropod eggs can be studied indirectly by measuring the change in size of the eggs, measurements were made, at intervals until hatching occurred, of newly-laid eggs from a laboratory colony of *Culex tarsalis* Coq. and from females of *Aëdes nigromaculis* (Ludl.) caught in the field in California, placed on wet filter paper. The following is taken from the author's summary of the observations. Although the rate of expansion of the eggs varied directly with temperature, the final size was independent of it; both infertile and fertile eggs increased in size, but the former did so more than the latter. Eggs of *C. tarsalis* exposed to water on filter paper increased in length more than eggs submerged in mineral oil, indicating that the expansion of the eggs was due to the absorption of water. The rates of expansion in the eggs of the two species were related to their respective habitats; eggs of *C. tarsalis*, which are laid on water, increased in size until hatching, whereas those of *A. nigromaculis*, which are deposited on drying soil where free water is available for only a short time, increased in size rapidly at first and reached their maximum size within 21 hours, after which no further change was apparent. Expansion of the eggs of *A. nigromaculis* ceased when the embryonic membrane appeared.

Bhatia (M. L.), Wattal (B. L.), Mammen (M. L.) & Kalra (N. L.). **Seasonal prevalence of Anophelines near Delhi.**—*Indian J. Malar.* **12** no. 1 pp. 13–38, 9 graphs (1 fldg.), 1 map, 12 refs. Kanpur, 1958.

The following is taken from the authors' summary of the results of their observations, made in 1953–1957, on the seasonal prevalence of 10 species of *Anopheles* in buildings housing man, cattle or both in three unsprayed villages near Delhi. *A. annularis* Wulp was the dominant species and was present throughout the year. *A. subpictus* Grassi, the second most common species, was abundant in the monsoons but not in other seasons. *A. culicifacies* Giles, the only known vector of malaria in the area, was common throughout the investigations, with peaks in April–May and August–December. The other species were much less numerous.

Sharma (M. I. D.) & Kalra (R. L.). **Note on the quantitative estimation of the degree of D.D.T. resistance in** *A. subpictus* **Grassi, 1899 in Delhi State.**—*Indian J. Malar.* **12** no. 2 pp. 93–100, 3 graphs, 7 refs. Kanpur, 1958.

The following is based on the authors' summary. Tests carried out near Delhi in 1957 showed the LC50's of DDT after different periods of exposure of adults of *Anopheles subpictus* Grassi from an unsprayed village to be higher than those obtained in 1955 and 1956, and this lessened susceptibility was ascribed to close proximity to villages that had been sprayed with DDT since 1947 [*cf. R.A.E.*, B **48** 45, 47, etc.]. The LC50's for adults obtained from the sprayed villages in 1957 showed them to be over 50 times as resistant to DDT as adults that had been obtained from the unsprayed area in 1955. Larvae from sprayed villages were 2–4 times as resistant to DDT as those from the unsprayed village.

Subramaniam (H.), Ramoo (H.) & Sumanam (S. D.). **Filariasis survey in the Laccadive, Minicoy and Amindivi Islands—Madras State.**—*Indian J. Malar.* **12** no. 2 pp. 115–127, 1 map, 4 refs. Kanpur, 1958.

The following is taken from the authors' summary. In a filariasis survey carried out in the Laccadive Islands, from December 1954 to February 1955, *Wuchereria bancrofti* was the only type of infection noted in man, and *Culex pipiens fatigans* Wied. the only mosquito naturally infected. There was no infection in man or mosquitos in Minicoy.

Sundararaman (S.). **The behaviour of *A. sundaicus* Rodenwaldt in relation to the application of residual insecticides in Tjilatjap, Indonesia.**—*Indian J. Malar.* **12** no. 2 pp. 129–156, 3 graphs, 1 map, 9 refs. Kanpur, 1958.

The following is taken from the author's summary and conclusions. Observations made near Tjilatjap on the south coast of Java in 1952–56 showed *Anopheles sundaicus* (Rdnw.) to be the principal vector of malaria with *A. subpictus* Grassi as a subsidiary vector in some areas. *A. sundaicus* was highly anthropophilic and largely endophagous and fed throughout the night, but mainly after midnight. The mosquitos generally rested on wall surfaces before and after feeding and during the day. Treatment of houses with deposit sprays of DDT at first gave good control of *A. sundaicus* but failed after 3–4 years. As the adults were still almost as susceptible to the insecticide as before, the failure is attributed to an alteration in the behaviour of the mosquitos, of which a large proportion avoided contact with sprayed surfaces. Dieldrin was used instead of DDT in the fifth year, but the results were similar.

Raghavan (N. G. S.), Nair (C. P.) & Krishnan (K. S.). **Filariasis in Travancore-Cochin (Kerala State). Part III. Hill-tribe settlements in Quilon and Trivandrum districts.**—*Indian J. Malar.* **12** no. 3 pp. 183–193, 1 graph, 5 refs. Kanpur, 1958.

The following is substantially the authors' summary. A malaria and filariasis survey was made in some of the forest settlements in the Quilon and Trivandrum districts of the State of Kerala (Travancore-Cochin) between December 1956 and February 1957 [*cf. R.A.E.*, B **46** 147, 200]. Incidence of malaria was almost nil at the time of the survey. The only filarial infection was with *Brugia* (*Wuchereria*) *malayi*, which had nocturnal periodicity. The vector of filariasis in this region was *Mansonia* (*Mansonioides*) *uniformis* (Theo.) which entered dwellings mainly during the early hours of the night.

Nair (C. P.) & Radhagovinda Roy. **Filariasis in Kerala State. Part IV. Filaria survey of Eriyad Panchayat, Cranganore Taluk.**—*Indian J. Malar.* **12** no. 3 pp. 195–201, 1 map, 6 refs. Kanpur, 1958.

The following is taken from the authors' summary. A filariasis survey was carried out in Eriyad Panchayat, a coastal area of Kerala State (Travancore-Cochin) in December 1957 [*cf.* preceding abstract, etc.]. The only filarial infection was with *Brugia* (*Wuchereria*) *malayi*. *Mansonia* (*Mansonioides*) *annulifera* (Theo.) was the main vector and *M.* (*M.*) *uniformis* (Theo.) a secondary one.

Sharma (M. I. D.), Krishnamurthy (B. S.) & Singh (N. N.). **Note on the susceptibility to D.D.T. of houseflies of Delhi and Rajasthan.**—*Indian J. Malar.* **12** no. 3 pp. 203–207, 1 fldg. table, 11 refs. Kanpur, 1958.

The F_2 generations of strains of *Musca domestica nebulo* F. and *M. d. vicina* Macq. from a DDT-sprayed village near Delhi were found to be more resistant to DDT than those of strains of these house-flies from an unsprayed village in Rajasthan.

Rahman (J.), Singh (M. V.) & Datta (S. P.). **Study of the residual toxicity of dieldrin in Hardoi district (Uttar Pradesh).**—*Indian J. Malar.* **12** no. 3 pp. 231–239, 4 graphs, 1 map, 6 refs. Kanpur, 1958.

The following is based mainly on the authors' summary. In 1957, buildings housing man, cattle and both in Hardoi district (Uttar Pradesh) were sprayed with 50 per cent. dieldrin wettable powder at a rate of 12·5 mg. per sq. ft. The weekly densities of Anophelines and Culicines remained low for seven and four weeks, respectively, and 50 per cent. mortality was given for nine and three weeks, respectively. *Anopheles culifacies* Giles and *A. stephensi* List. were not caught for eight weeks, and the species commonly recorded after the treatment were *A. subpictus* Grassi, *A. annularis* Wulp and *A. pallidus* Theo. in order of decreasing frequency, the first species remaining numerous throughout the 10 weeks of post-treatment observation.

Casals (J.). **The Arthropod-borne group of animal viruses.**—*Trans. N. Y. Acad. Sci.* (2) **19** no. 3 pp.219–235, 2 figs., 13 refs. New York, N. Y., 1957.

Developments in the classification of arthropod-borne viruses of man and animals into groups on the basis of immunological cross-reactions and the significance, both in nature and in experimental work, of these groups are discussed, and the results of a study of the classification of 47 viruses are given in a table. Seven viruses (Semliki forest [*R.A.E.*, B **34** 87], chikungunya [**48** 216, etc.], Mayaro [**48** 90] and Sindbis [**45** 101] and the viruses of eastern, western and Venezuelan equine encephalitis) are included in the previously designated group A and 17 (including the viruses of yellow fever, louping ill, two types of dengue and Russian spring-summer, Japanese B, Murray Valley and St. Louis encephalitis, and the Ilhéus [**38** 107], Ntaya [**42** 163], Uganda S [**42** 164], West Nile [**31** 203] and Zika [**42** 164] viruses) in group B, and three viruses isolated from animals in Brazil in a newly designated group C. The remaining 20 could not at the time be classified.

Holden (P.) & Hess (A. D.). **Cache Valley virus, a previously undescribed mosquito-borne agent.**—*Science* **130** no. 3383 pp. 1187–1188, 4 refs. Lancaster, Pa., 1959.

A virus that caused encephalitis in intracerebrally inoculated weanling mice was isolated from a pool of 50 adults of *Culiseta inornata* (Will.) taken under a bridge in northern Utah in August 1956 and was named Cache Valley virus after the locality in which the mosquitos were collected. It was found to belong to the Bunyamwera group of arthropod-borne viruses [*cf. R.A.E.*, B **49** 204]. Sera from horses living in the same area neutralised the virus. Its possible medical or veterinary importance is being studied.

Kokernot (R. H.), Smithburn (K. C.), Paterson (H. E.) & McIntosh (B. M.). **Isolation of Germiston virus, a hitherto unknown agent, from Culicine mosquitoes, and a report of infection in two laboratory workers.**—*Amer. J. trop. Med. Hyg.* **9** no. 1 pp. 62–69, 1 map, 16 refs. Baltimore, Md., 1960.

Two strains of virus were isolated from Culicine mosquitos collected with human bait from reed-beds at Germiston Lake near Johannesburg, South

Africa, in April 1958. One was derived from a mixed pool of five females of *Culex theileri* Theo. and 12 of *C. rubinotus* Theo., and the other from a pool of 11 females of *C. rubinotus*. Serological tests indicated that they were antigenically indistinguishable, and the name Germiston virus is applied to them. The virus was shown to be related to, but not identical with, Bunyamwera virus [*cf.* next abstract but one]. Mice immunised with Bunyamwera virus were not significantly protected against Germiston virus. Two clinical cases of infection occurred in laboratory workers engaged in serological studies of the virus. It is suggested that it may have been introduced to the area by cattle egrets (*Bubulcus ibis*) or other birds living among the reeds.

Anderson (C. R.), Aitken (T. H. G.), Spence (L. P.) & Downs (W. G.). **Kairi virus, a new virus from Trinidadian forest mosquitoes.**—*Amer. J. trop. Med. Hyg.* **9** no. 1 pp. 70–72, 4 refs. Baltimore, Md., 1960.

Ten out of 27 disease agents isolated in baby mice from mosquitos taken while biting man in the Melajo forest in north-eastern Trinidad in 1955 were shown to be strains of a virus apparently new to science. The name Kairi (island) virus is proposed for it. An eleventh strain was recovered in 1958 from southern Trinidad. Four of the strains came from pools of *Aëdes scapularis* (Rond.), two from pools of *Psorophora ferox* (Humb.), one each from *Culex spissipes* (Theo.), *Wyeomyia aporonoma* D. & K. and *W. ypsipola* Dyar, and two from pools of undetermined species of *Wyeomyia*. All the 1955 isolations were made within a period of seven weeks in August–September; the 1958 strain was also isolated in August. The behaviour of the strains in mice showed that they clearly differed from all the viruses of Group A (Venezuelan and eastern equine encephalitis and Mayaro) or Group B (yellow fever, dengue, St. Louis encephalitis and Ilhéus) then known or suspected to occur in Trinidad [*cf. R.A.E.*, B **48** 10, 90], but were related to Bunyamwera virus [*cf.* next abstract]. Neutralising antibodies for Kairi virus were found in human and donkey sera and the sera of *Cebus* and howler [*Alouatta*] monkeys in Trinidad, but it is uncertain whether Kairi virus or some other closely related virus was involved.

Casals (J.) & Whitman (L.). **A new antigenic group of arthropod-borne viruses. The Bunyamwera group.**—*Amer. J. trop. Med. Hyg.* **9** no. 1 pp. 73–77, 11 refs. Baltimore, Md., 1960.

An account is given of work as a result of which four previously unclassified viruses were found to be related serologically among themselves but not with those of groups A, B or C [*R.A.E.*, B **49** 203]; they form a hitherto unrecognised group, for which the designation Bunyamwera group is proposed. The viruses in question are Bunyamwera virus [**37** 150], *Wyeomyia* virus [**38** 107], Cache Valley virus [**49** 203] and Kairi virus [see preceding abstract]. Of two strains of virus isolated by O. R. Causey from pools of *Aëdes scapularis* (Rond.) caught in the forest near Belem in the Brazilian State of Pará, one was found during the investigations to be identical with Cache Valley virus and the other with Kairi virus. It is stated in an addendum that other virus isolates recently received from Africa, India and South America have been found to belong to the new group. They include the Germiston virus [*cf.* **49** 203].

KARTMAN (L.), MILES (V. I.) & PRINCE (F. M.). **Ecological studies of wild rodent plague in the San Francisco Bay area of California. I. Introduction.**—*Amer. J. trop. Med. Hyg.* **7** no. 1 pp. 112–124, 3 figs., 34 refs. Baltimore, Md., 1958.

QUAN (S. F.), VON FINTEL (H.) & MCMANUS (A. G.). **II. Efficiency of bacterial culture compared to animal inoculation as methods for detecting** *Pasteurella pestis* **in wild rodent fleas.**—*T. c.* no. 4 pp. 411–415, 17 refs.

QUAN (S. F.), MILES (V. I.) & KARTMAN (L.). **III. The natural infection rates with** *Pasteurella pestis* **in five flea species during an epizootic.**—*Op. cit.* **9** no. 1 pp. 85–90, 21 refs. 1960.

QUAN (S. F.), KARTMAN (L.), PRINCE (F. M.) & MILES (V. I.). **IV. The fluctuation and intensity of natural infection with** *Pasteurella pestis* **in fleas during an epizootic.**—*T. c.* pp. 91–95, 1 fig., 15 refs.

KARTMAN (L.), QUAN (S. F.) & MILES (V. I.). **V. The distribution of naturally infected fleas during an epizootic in relation to their infection rates.**—*T. c.* pp. 96–100, 2 figs., 10 refs.

The following paragraphs are abstracts of these five papers, respectively, and all but the first are substantially the authors' summaries.

There is a vast reservoir of plague in wild rodents and their fleas in the west of the United States, especially California, from which infection might spread to the human population [*cf. R.A.E.*, B **40** 19–20, **48** 92–93], and the danger has been increased by suburban building and increased visiting of wild recreational areas. However, the most serious threat is from transfer of infection from wild rodents to domestic rats (*Rattus* spp.), and it is noted that some inconspicuous small rodents may have closer association with these than do ground squirrels (*Citellus*) and other colonial species. Intensive ecological study of the relations between hosts, ectoparasites and disease in plague foci, especially those near human populations, is needed. The work described in these papers was a study, begun in March 1954, of an epizootic plague focus in the San Bruno Mountains near San Francisco [**48** 92], in which native field mice were closely associated with domestic rats (*Rattus norvegicus*) near human dwellings [*cf.* **47** 159]. As inoculation of laboratory animals with pools of fleas does not provide definite data on natural plague infection rates in fleas, a method was devised for detecting the infection of individual fleas with *Pasteurella pestis* by agar-plate culture, and individual cultures were made from all fleas collected during six consecutive weeks beginning in the second week of the study and during a similar period of high plague prevalence in February and March 1955. In the interim, the method was used intermittently. Plague was isolated from each of three pools of fleas from three groups of trap sites. The three pools each consisted mainly of *Malaraeus telchinum* (Roths.), with a few individuals of other species, including *Atyphloceras multidentatus* (Fox), and the hosts were *Microtus californicus* and *Peromyscus maniculatus*, *M. californicus* and *Reithrodontomys megalotis*, and *P. maniculatus*, respectively. Four fleas collected from one meadow vole (*Microtus californicus*) at another site comprised an individual of *Hystrichopsylla linsdalei* Holland, which was not infected, and three examples of *Malaraeus telchinum*, from a pool of which infection was obtained. In the next trapping, fleas were separated into smaller pools and *Pasteurella pestis* was isolated three times from *M. telchinum* and once each from *Opisodasys keeni nesiotus* Augustson and *H. linsdalei*, all taken on *Microtus californicus*. *P. pestis* was isolated from tissues of a rat (*R. norvegicus*) found dead in a trap. This unusual prevalence in the area provided an opportunity for detailed study of wild-rodent plague in close proximity to man.

The effectiveness of the two methods of detecting infection is evaluated in the second paper. Studies with 1,297 fleas collected from live-caught wild rodents, cultured individually for bacilli and then inoculated as 319 pools into animals, showed at least 99 to contain *P. pestis*. The efficiency ranges of the two methods were 68–87 per cent. for culture and 59–98 per cent. for animal inoculation, but the averages were 79 and 89 per cent., respectively. The effectiveness of culturing appeared to be the same irrespective of the concentration of *P. pestis* in the flea, but success of animal inoculation varied with the density of plague bacilli. It was about 60 per cent. when the number per flea was low, and over 90 per cent. when the number was very high. Both methods are simple and are highly sensitive in detecting the presence of plague organisms in fleas such as *Malaraeus telchinum* and *H. linsdalei*. The culture method is rapid, does not need animal facilities and permits examination of large numbers of fleas individually but does not allow pools to be tested. The animal inoculation of flea pools has few interfering factors, is more effective and allows of the pooling of large numbers of fleas for few injections. Because *P. pestis* occurs so rarely in fleas in nature, animal inoculation remains the method of choice for surveillance, but individual culture provides invaluable data for the critical study of epizootic plague among wild rodents and their fleas [*cf.* **48** 225].

Rates of infection with *P. pestis* in 2,202 fleas belonging to nine species were determined by individual culture and are reported in the third paper. Plague organisms were found in 5 per cent. of them. *M. telchinum*, *H. linsdalei*, *Catallagia wymani* (Fox), *A. multidentatus* and *O. k. nesiotus* comprised, respectively, 70·7, 11·2, 9, 6·6 and 2·1 per cent. of the total and had infection rates of 4·8, 11·3, 0·5, 2 and 6·5 per cent., respectively. Of the total number of fleas found infected, *M. telchinum* constituted 68 per cent., *H. linsdalei* 25 per cent., and the other three species together 7 per cent. The main vectors during the epizootic appeared to be *H. linsdalei* and *M. telchinum*. Infection rates in fleas seemed to bear no relation to sex, but females were taken in greater numbers than males.

The numbers of plague bacilli in the infected fleas collected during the epizootic, as recorded in the fourth paper, ranged from a few to millions. Fleas with both large and small numbers of bacilli were present during the first three weeks of the six-weeks observation period, but all fleas found infected during the last three weeks had massive infections. The intense infections that occurred in species such as *M. telchinum* and *H. linsdalei* while the epizootic was declining suggest a reservoir mechanism, which may be based on a slow development of *P. pestis* in certain species of wild-rodent fleas under appropriate atmospheric conditions. Correlation between infection rates of individual fleas and their faeces was generally poor. Similarly, estimates of infection based on visual observation of plague masses in the intestinal tract of fleas were poorly borne out by subsequent culture. These findings confirmed earlier experimental results [**48** 225]. Observations on the fluctuation of infection in fleas suggested that the epizootic began in late February and lasted for about eight weeks (until the end of April) with vigorous activity during the middle four weeks and the peak during the third week. It appeared probable that the availability of susceptible rodents was a limiting factor.

Observations on the distribution of infected fleas, described in the last paper, showed their concentration to be greatest over an area of about 120,000 sq. ft. of coastal brush vegetation on a loam-type soil. They were also found in a contiguous area to the west and north-west of the main focus, but the much lower infection rate in this adjacent area suggested that it had been initiated by spread from the epizootic focus. The evidence from the distribution of infected fleas and their infection rates suggests that the epizootic among the wild rodents was strongly localised. No instance of spread at a distance was noted. The number of trap sites (each of 2,500 sq. ft.) on which infected fleas were found fell steadily from a maximum of 25 during the first week of observations to two in the sixth week. There was a decline in total trap sites yielding infected fleas each week and in the number of new trap sites that did so, and a concomitant decline in flea infection rates. The presence of commensal rats (*R. norvegicus*) in a plot contiguous to the epizootic focus, and the finding of an individual of *R. norvegicus* that had died from plague, suggested that the route of possible major spread was into the rat population. This appeared to have been prevented by a prompt rat control campaign by local health authorities.

LUMSDEN (W. H. R.). **A trap for insects biting small vertebrates.**—*Nature* **181** no. 4612 pp. 819–820, 1 fig., 4 refs. London, 1958.

MINTER (D. M.). **A modified Lumsden suction-trap for biting insects.**—*Bull. ent. Res.* **52** pt. 2 pp. 233–238, 1 pl., 3 figs., 1 ref. London, 1961.

The trap described in the first paper was designed to enable the biting insects attacking small animals to be sampled without the complication introduced by a human catcher and without using the principle of restricted inlets, which deter some species from entering and allow a proportion to escape. A motor-driven fan is mounted, on an iron frame over the centre of a hardboard platform on which the bait animal is exposed, so as to give an upward draught. A conical space extending downwards from the base of the fan assembly to within 15 cm. of the platform is partly enclosed by truncated sectorial pieces of transparent cellulose-acetate sheet between the edges of which are spaces about 1 cm. wide. Above the fan, a metal cylinder carries a wire-gauze funnel leading at right angles into a small chamber fitted with a collecting bottle containing a killing agent. The fan is turned on and off at intervals by a simple automatic mechanism. Of the rhythms tested, alternating periods of 2½ minutes on and 5 minutes off were found most satisfactory. Thus, the bait is as nearly as possible freely exposed and the insects flying near it are sampled at regular intervals. Nearly 500 mosquitos (mostly *Mansonia* (*Taeniorhynchus*) spp.) were taken per night with a rabbit as bait in five nights at Entebbe, Uganda.

A modification of the trap was devised in Kenya during studies on small Diptera, especially *Phlebotomus* and *Culicoides*, and is described in the second paper. The trap was designed to be portable, battery-operated, simple, robust and easy to handle, transport, operate and maintain, as well as adaptable for bait animals of various sizes and capable of collecting very small insects alive and undamaged. The platform is of sheet metal. The cage is formed of slotted sheets of Perspex, arranged on a metal frame in the shape of a truncated pyramid and supported above the platform at a height (0–6 in.) that can be adjusted to suit the size of the animal and air conditions. The base supporting the motor and fan serves as the roof of the cage. The vertically mounted fan is covered by a sheet-metal cylinder surmounted by a helmet that deflects air from the fan through a right angle into a gauze-sided sheet-metal funnel, from which the insects are delivered into a plastic collecting jar closed by a gauze panel through which the air stream can pass, so that turbulence is kept to a minimum. The same rhythm was used as before, but if it is desired to allow the insects to feed on the bait animal before they are trapped, it would be necessary to increase the " off " periods.

Morris (K. R. S.). **Problems in the assessment of tsetse populations.**—*Bull. ent. Res.* **52** pt. 2 pp. 239–256, 2 figs., 11 refs. London, 1961.

The following is virtually the author's summary. A detailed tsetse-fly survey of 41,000 sq. miles in the inland savannah zone of the Gold Coast (Ghana) was completed in five years with an entirely African staff working only six months of each year. This undertaking was made possible because studies of the species of *Glossina* concerned, *G. palpalis* (R.-D.), *G. tachinoides* Westw. and *G. morsitans submorsitans* Newst., had provided knowledge of their habitat, hosts and activity rhythm, on which could be based a standard yet simple survey technique, within the compass of independent teams of Africans. The restricted activity of the flies, subject to both daily and seasonal variations, meant that nothing less than a ' day ' of eight hours of observation could be accepted as a valid sampling unit. With tsetse flies at low densities, a day's search was inadequate, giving only 40 per cent. reliability compared with six-day observations. Four days' search gave 90 per cent. reliability and was adopted as the minimum period. Each survey team was under the charge of a recorder or field assistant, with fly-boys devoting the whole of their time to catching. To ensure comparability of survey data, teams were kept to the same size, two fly-boys being the optimum, since it was found that the size of the catch was not always proportionate to the number of boys, the relationship varying according to a variety of factors. For making surveys of *G. palpalis* and *G. tachinoides*, the ' picket ' system of more or less stationary teams, measuring their catches by the ' day ', was found overwhelmingly superior to the fly-round technique.

This survey procedure for savannah woodland country was not effective for sampling *G. nigrofusca* Newst. in the Ashanti forest or *G. longipalpis* Wied. in the coastal savannah, but Morris's animal traps [*R.A.E.*, B **37** 110] were found to take both species readily in places where they had not been detected or had been caught only occasionally by fly-boys. Experiments showed that trap catches were superior, both numerically and in giving a more representative sample of the tsetse population present. It was also shown that trapping could be a valuable means of studying the biology of these two species that do not come readily to man. Traps were also effective in taking *G. pallicera* Big. and *G. medicorum* Aust. The greater value of traps compared with fly-boys as a means of sampling various species of tsetses is discussed, and suggestions are put forward for the development of trapping as a method of survey.

Brooke Worth (C.), de Sousa (J.) & Weinbren (M. P.). **Studies on the life-history of** *Aëdes* (*Skusea*) *pembaensis* (**Theobald**) (**Diptera, Culicidae**).—*Bull. ent. Res.* **52** pt. 2 pp. 257–261, 7 refs. London, 1961.

The following is substantially the authors' summary. The observation in Kenya that *Aëdes pembaensis* (Theo.) breeds in association with the crab, *Sesarma meinerti* de Man [*R.A.E.*, B **46** 150], was duplicated at Lumbo, on the coast of northern Mozambique. Eggs were seen in abundance on crabs living in colonies among mangroves at the edge of a tidal estuary. Females of *A. pembaensis* were caught in gradually decreasing abundance at collecting sites progressively further inland from the head of the estuary, and males were almost confined to the breeding area. Swarms of males were not seen, and it is thought that mating takes place within the crabs' burrows. Populations of *A. pembaensis*, which formed 61–69 per cent. of the mosquitos caught at Lumbo in 1959–60, were similar in the two years, whereas numbers of some species that breed in fresh water were reduced in 1960 owing to low rainfall. The estuarine environment, regulated by the tides, is apparently more stable than are terrestrial habitats, and the numbers of *A. pembaensis* may therefore be expected to be less variable than those of mosquitos dependent on fresh water. Females disturbed at a crab colony bit spontaneously in the day-time. Captive ones given the opportunity of feeding on three men showed a marked preference for one of them, and he experienced a severe reaction to the bites, whereas the other two experienced none whatever. Precipitin tests indicated that man was the only source of blood for *A. pembaensis*, but the finding was probably biased by the method of collection. Eight strains of an apparently new virus were isolated from females of *A. pembaensis* in 1959 and four in 1960. In addition, two strains of a virus of the Bunyamwera group [*cf.* **49** 204] were isolated in 1960. The incidence of antibodies against the 1959 virus in human sera was low. This, with a rather high incidence of the virus in the mosquito, suggests that the latter might have acquired the virus from a non-human source, and does not support the evidence that suggests man as the chief or only source of its blood-meals at Lumbo.

FOSTER (R.), WHITE (P. J.) & YEO (D.). **Aircraft applications of insecticides in East Africa. XII. Preliminary attempts to reduce the cost of controlling the tsetse species** *Glossina morsitans* **Westw.,** *G. swynnertoni* **Aust. and** *G. pallidipes* **Aust. in savannah woodland.**—*Bull. ent. Res.* **52** pt. 2 pp. 293–303, 1 map, 11 refs. London, 1961.

BURNETT (G. F.), YEO (D.), MILLER (A. W. D.) & WHITE (P. J.). **XIII. An economical method for the control of** *Glossina morsitans* **Westw.**—*T. c.* pp. 305–316, 1 map, 14 refs.

The following paragraphs are substantially the authors' summaries of these two papers, which belong to a series [*cf. R.A.E.*, B **45** 23, etc.]. Following successful small-scale trials, an attempt was made, by application of insecticide from aircraft, to eradicate *Glossina morsitans* Westw. and *G. pallidipes* Aust. from an isolated block of savannah woodland, approximately 11 sq. miles in extent, at Chungai in the Central Province of Tanganyika between July 1958 and January 1959. A single-engined aircraft, fitted with two belt-driven rotary-cage atomisers, was used to apply a 5 per cent. solution of γ BHC in power kerosene as a coarse aerosol at a nominal dosage of 0·08 gal. per acre (0·04 lb. γ BHC per acre), in swaths 70 yd. wide. Seven applications were made at intervals of about 28 days, the time taken to complete an application varying from five to eight days. The operation failed to control the flies. Although each of the first two applications reduced the apparent density of *G. morsitans* by about 90 per cent. and that of *G. pallidipes* by a smaller, although still considerable, factor, later applications gave varying and often low mortalities, and the populations increased slowly for some time, the insecticide applications causing only temporary depressions in numbers. Numbers fell towards the end of the operation, but final reductions were only about 50 per cent. or less. Kills of females were low, and this undoubtedly led to the eventual failure. The low volume-dosage, a drop spectrum that possibly contained too few droplets of the required size, meteorological conditions, and biological factors that apparently favoured the survival of females are suggested as contributing to the low mortalities.

Between July 1959 and March 1960, the same aircraft was used to apply a 2·5 per cent. solution of dieldrin in oil at 0·125 gal. per acre (0·031 lb. toxicant per acre) to the same block in a further attempt to eradicate the two species of *Glossina*. Eight applications were made at intervals of about four weeks. Swath width was 55 yd., and the aircraft emitted the insecticide as a coarse aerosol as it flew in both directions over the block. The operation suffered delays, and three applications were incomplete to varying degrees. Kills of *G. morsitans* per application appeared to be 85 per cent. or higher, but the final reduction of 99·5 per cent. could theoretically have been attained with consecutive mortalities of only 65 per cent. It is suggested that this discrepancy may be due to the higher dose needed to kill old females, especially pregnant ones. *G. pallidipes* was also reduced by 99·5 per cent., as compared with 12 per cent. in the previous experiment. Numbers of flies were so reduced that large-scale settlement with cattle took place rapidly, and this, if continued, should complete the work of extermination. The experiment is compared with that described in the first paper. It is concluded that a combination of reduced swath width, greater volume dosage, a more lethal insecticide and smaller size of droplet containing a lethal dose, together with the more even coverage resulting from improved flying technique and the more reliable performance of the disseminating equipment, was responsible for the improved result. It is thought that without delays, interruptions, incomplete applications and reinfestation, even better results would be obtained. This was the cheapest and one of the most successful aerial operations carried out against savannah tsetse. Costs actually over the ground were £301 per sq. mile; incidental costs due to the locality of operations were £66 per sq. mile. There is little prospect of direct reduction of flying costs, but economies by the use of other insecticides or by more effective dispensing equipment producing no large drops are possible.

HADDOW (A. J.). **Studies on the biting habits and medical importance of East African mosquitos in the genus** *Aëdes*. **II. Subgenera** *Mucidus*, *Diceromyia*, *Finlaya* **and** *Stegomyia*.—*Bull. ent. Res.* **52** pt. 2 pp. 317–351, 11 figs., 5 pp. refs. London, 1961.

The following is mainly based on the author's summary of this second paper of a series [*cf. R.A.E.*, B **48** 76]. The cyclic biting behaviour of East African species of *Aëdes* in the subgenera *Mucidus*, *Diceromyia*, *Finlaya* and *Stegomyia*, as shown in 448 24-hour catches made predominantly in forest in Uganda [*cf.* **42** 60], are discussed with reference to the literature. Many species in these subgenera show arboreal tendencies of varying degree and, while a species may show a preference for some particular level, many of them appear to make daily vertical migrations. Consequently, biting may reach its maximum intensity at different times at different levels. Furthermore, the habits of a species may vary from one area to another, and therefore it is often best to discuss a representative series of catches from a productive area, noting such differences as may have been observed elsewhere. It has been found further that under certain circumstances, a species may fail to show a clear pattern of biting behaviour, and the possible reasons for this that are believed to be important are discussed; these are the use of a bait not normally attacked by the mosquito concerned, activity in an unfamiliar or unfavourable environment and the carrying out of observations on mosquitos that are travelling from the site of one activity to that of another.

All members of the subgenus *Mucidus* so far adequately studied are arboreal and nocturnal. The subgenus *Diceromyia* was badly represented, but the members of the group of *A. furcifer* (Edw.) and *A. taylori* Edw. are shown to be arboreal and crepuscular mosquitos, which will also bite freely at ground-level when forest or bush is scarce and which are very resistant to drought and heat. In the subgenus *Finlaya*, *A. ingrami* Edw. is a mosquito of the forest understorey, which bites most freely in the hour before sunset. It makes vertical migrations, however, and the biting cycle at ground-level differs from that in the trees. *A. longipalpis* (Grünb.) is a diurnal species of the forest canopy. A view put forward by the author in a paper already noticed [**42** 60], that the form of the biting cycle in this species could be attributed to different physiological groups biting at different times, can no longer be supported. In the subgenus *Stegomyia*, *A. dendrophilus* Edw. and *A. apicoargenteus* (Theo.) are diurnal species with rather irregular biting cycles, *A. dendrophilus* preferring ground level and *A. apicoargenteus* the understorey. The biting cycle of *A. simpsoni* (Theo.) is also diurnal and rather irregular, but usually shows its highest level in the afternoon, particularly in forest. *A. africanus* (Theo.) is a crepuscular species of the forest canopy, which does, however, make vertical migrations and which may be driven down to low levels by wind. At ground level, its biting cycle is entirely different from that obtaining above, being mainly diurnal. *A. ruwenzori* Haddow & van Someren is also arboreal and crepuscular but reaches its peak in the hour before sunset. Scarcer species are also discussed briefly.

Members of the subgenus *Mucidus* are not known to be involved in disease transmission, and no virus has been isolated from mosquitos of the subgenus *Diceromyia*, though members of the group of *A. furcifer* and *A. taylori* were suspected of transmitting yellow fever in the Sudan [**31** 21; **32** 25]. The position in the subgenus *Finlaya* is also uncertain. It is considered likely that there may be a diurnal, arboreal vector of yellow fever in the African rain-forest [*cf.* **41** 147] and that this may be *A. longipalpis*, and either this species or *A. ingrami* was probably the species from which the original isolation of Uganda S virus was made [**42** 164]. It is the subgenus *Stegomyia* that includes the species of great importance in virus transmission. *A. aegypti* (L.) transmits yellow fever and dengue and is a laboratory vector of many other viruses. Its chief importance in East Africa is as a vector of chikungunya, a dengue-like disease that occurred in Tanganyika in 1952–53 [**43** 206–207; **48** 216]. Yellow fever, chikungunya virus and Zika virus [**48** 239, etc.] and the Lunyo strain of the virus of Rift Valley fever [*cf.* **47** 182] have all been isolated from *A. africanus* in Uganda. *A. simpsoni* is an important vector of human yellow fever in western Uganda. The virus of Rift Valley fever was isolated from *A. dendrophilus* in the Semliki Forest in 1944. It was referred to as *A. deboeri* subsp. *demeilloni* Edw. in the author's earlier papers [*cf.* **48** 11], owing to confusion arising from a transposition in a figure legend in Hopkins' work on the larvae of Ethiopian Culicines [**24** 123]. *A. dendrophilus* is rather uncommon in Uganda except in the Semliki Forest.

KETTLE (D. S.). **A study of the association between moorland vegetation and breeding sites of *Culicoides* (Diptera, Ceratopogonidae).**—*Bull. ent. Res.* **52** pt. 2 pp. 381–411, 11 figs., 5 refs. London, 1961.

The following is virtually the author's summary of the results of surveys in which samples of larvae of *Culicoides* were taken from different situations in moorland areas of Scotland. A major problem in using larvicides to control *Culicoides* is to recognise the sites requiring treatment. The relation between plant cover and breeding of *Culicoides* (mainly *C. impunctatus* Goetgh.) was accordingly investigated. Two sites were examined on Soutra Hill, Midlothian, and one each on Bannachra Muir and at Luss, Dunbartonshire. Three vegetational zones were recognised at site 1 on Soutra: bogland

(I), acid grassland (III) and a zone (II) characterised by vegetation preferring a much wetter habitat than either of the foregoing. *C. impunctatus* was virtually the only species of *Culicoides* found in zone I; it was relatively less abundant in zone II, where *C. albicans* (Winn.) reached its peak, and occurred most densely at the bogland edge of zone III, where it was associated with *C. cubitalis* Edw., *C. heliophilus* Edw. and *C. obsoletus* (Mg.). Further into the grassland, *C. impunctatus* decreased, while the other three species became more numerous and other species, of the group of *C. pulicaris* (L.), appeared. Within each main zone, there were no significant differences between the various floristic groups as regards larval densities. Fluctuations in population density observed in late autumn were regarded as more apparent than real, and attributable to larval movement in response to an oscillating factor, possibly soil-water level. This movement was recognisable in all zones but was most strongly marked where the ground was uneven.

At site 2 on Soutra, where only zones I and III were sampled, there was remarkable consistency among the larval densities of the various groups of samples examined. This applied whether the samples were classified on their angiosperm flora, moss cover or spatial arrangement. The main source of variation was within groups, and it was found that two adjacent small plots (12 yd. × 12 yd.) that were macroscopically identical showed consistent differences over a period of ten months, covering the transition from one generation to another. On Bannachra Muir, the larvae of *C. impunctatus* were concentrated in an area covered by *Juncus articulatus* and *Sphagnum* where the water flowed down the hillside near the surface. *C. impunctatus* avoided both an area of drier leaf mould and a stagnant ditch. *C. albicans*, *C. heliophilus* and *C. obsoletus* preferred the ditch to the hillside flow. Around a hillside trickle at Luss, larvae of *C. impunctatus* and *C. truncorum* Edw. were abundant in subequal numbers. In spite of the restricted size of the area (about 10 sq. yd.), they never occurred in equal numbers in any set of samples, but one or the other predominated. *C. truncorum* showed a preference for the very wet parts.

SAUNDERS (D. S.). **Laboratory studies on the biology of** *Syntomosphyrum albiclavus* **Kerrich (Hym., Eulophidae), a parasite of tsetse flies.**—*Bull. ent. Res.* **52** pt. 2 pp. 413–429, 6 graphs, 27 refs. London, 1961.

The following is substantially the author's summary. Laboratory studies are reported on *Syntomosphyrum albiclavus* Kerrich, a Eulophid of interest as a pupal parasite of tsetse flies [*cf. R.A.E.*, B **48** 105–106]. Material was obtained from puparia of *Glossina morsitans* Westw. collected in Tanganyika and sent by air to London, and a culture was established on *Lucilia sericata* (Mg.). 'Natural' and 'unnatural' hosts of the Eulophid were investigated. It parasitised pupae of all species of *Cyclorrhapha* offered in the laboratory, but has been recorded only from *Glossina* in nature. The conditions that make a host suitable for *S. albiclavus* are discussed. The most important is the presence of the space between the pupa and the puparium in which the eggs are laid [**48** 106] and without which a host is unacceptable. *S. albiclavus* also bred on dead pupae and in puparia containing other parasites. The number of adults emerging from a host puparium was directly proportional to its weight. The fecundity of *S. albiclavus* was very variable and depended on the weight of host material consumed during larval life, which, in turn, reflected the density of the parasites in the host puparium from which the females emerged.

The duration of the parasitic phase of the life-cycle, the length of life of the adults and the rate of maturation of the ovaries were functions of temperature; constant maintenance at 35°C. [95°F.] was fatal to the eggs. Length of life was also affected by the relative humidity, increased mortality occurring in low humidities and in saturated air, with an optimum for survival at about 80 per cent. relative humidity. At 25°C. [77°F.], eggs were not laid until the third day after emergence; the daily number of offspring produced then fell off with increasing age of the female, and very old females, although attacking hosts, were unable to oviposit.

Bennett (G. F.). **On some ornithophilic blood-sucking Diptera in Algonquin Park, Ontario, Canada.**—*Canad. J. Zool.* **38** no. 2 pp. 377–389, 1 pl., 8 refs. **Ottawa, 1960.**

A study was made in Algonquin Park, Ontario, of the Diptera that fed on various birds exposed in different habitats and at different times in May–July in the years 1956–59. The birds were confined in mesh cages with hardware cloth floors, and all except ducks and very small species were hooded. The small birds were restrained in tubes of wire mesh, and the ducks soon became quiet without the use of hoods. The exposure cages were placed on squares of white plywood at the test sites, and collecting cages of nylon gauze (60 meshes to the inch) were dropped over them after an exposure period of 20–30 minutes. Strips of plastic or rubber sponge glued to the bottom of the frame prevented the insects from escaping. The collecting cages were left in position for 20–30 minutes, and engorged flies that settled on the sides were collected with aspirators through a sleeve at the top. For collecting from different heights, the exposure cages containing the birds were raised by a pulley, left in position for 20–30 minutes, then carefully lowered in 30–40 seconds to the plywood squares and the engorged flies recovered as before. The Diptera collected are shown in tables; they were mostly Simuliids and species of *Culicoides*, but some mosquitos (chiefly *Mansonia perturbans* (Wlk.)) and Tabanids were also taken. The Simuliids and Ceratopogonids included several undescribed species and species the feeding habits of which were previously unknown, and were found to show host and habitat preferences.

De Meillon (B.), Davis (D. H. S.) & Hardy (F.). **Plague in Southern Africa. Volume I. The Siphonaptera (excluding Ischnopsyllidae).**—$9\frac{3}{4} \times 7$ in., viii + 280 pp., 364 figs., 37 maps (1 fldg.), 53 refs. Pretoria, Govt. Printer, 1961. Price *R*4 or £2.

Southern Africa is defined for the purpose of this work as that part of the continent lying south of the Zambesi River and the northern international borders of the Caprivi Strip and South West Africa, and including the whole of South Africa, South West Africa, the High Commission Territories, Southern Rhodesia and southern Mozambique. Plague does not occur in Southern Rhodesia or Mozambique but was recorded between 1919 and 1959 in both man and rodents in South Africa, South West Africa and the Bechuanaland Protectorate. It persists in rodents throughout the semi-arid and arid parts of the area and is a major health problem. On this account, an intensive programme of research was begun in 1938. The findings on fleas are published in the present volume, and it is planned to produce a second in which the small mammal hosts will be dealt with on lines similar to those followed for the fleas, and a third devoted to the ecological problems of plague.

This first volume contains descriptions of the essential characters of all the fleas known to occur in southern Africa (except Ischnopsyllids) together with keys to families, subfamilies, genera and species and numerous specially prepared illustrations. The geographical distribution of each species is given, records are plotted on maps and, where possible, an attempt is made to correlate distribution with environmental factors. A list of the Siphonaptera of the Ethiopian region (excluding the Ischnopsyllidae) is included, and in it the species that occur only in southern Africa are designated. The frequency of occurrence of each species on its various hosts is tabulated, and information is given on the status of each species as a plague vector and on its ecology where information is adequate.

Deoras (P. J.) & Joshee (A. K.). **Proventricular teeth in some rat fleas.**—*Indian J. med. Res.* **47** no. 3 pp. 261–265, 2 pls., 14 refs. New Delhi, 1959.

A small difference in the structure of the proventricular valve of fleas of different species might influence considerably the facility with which members of a species could become blocked by plague bacilli. The position of the plug is, to some extent, characteristic of a given species and is controlled by the structure and physiological activity of the alimentary canal. There are indications that female fleas may be better vectors of plague than males [*cf.* *R.A.E.*, B **46** 163], and the structure of the proventriculus in the two sexes may be one of the factors responsible. In view of these facts, the proventriculus of some Bombay rat fleas was studied. In *Xenopsylla cheopis* (Roths.), *X. astia* Roths., *X. brasiliensis* (Baker) and *Ctenocephalides felis* (Bch.), the only species of which both sexes were studied, the females had a considerably larger proventriculus and nearly twice as many proventricular teeth as the males. The number of teeth appears to increase with age. The results suggest that an older flea may be able to suck more blood and develop a bigger block than a younger one, and a female more than a male.

Feldman-Muhsam (B.). **The South African ticks** *Rhipicephalus capensis* **Koch and** *R. gertrudae* **n. sp.**—*J. Parasit.* **46** no. 1 pp. 101–108, 6 figs., 9 refs. Lancaster, Pa., 1960.

Material determined by several acarologists as *Rhipicephalus capensis* Koch was found on examination to show marked variations in many characters, and, if a complex of variable characters was considered, types could be differentiated that were constant in one or more respects. Examination of the mounted genital aperture of the female revealed the existence of two distinct types with no transitional forms, and these were found to be recognisable by several macroscopic characters in both sexes. One, determined by comparison with Koch's holotype male, is described as *R. capensis*, and the other is described as *R. gertrudae*, sp. n., in each case from adults of both sexes. Both occur in South Africa and apparently also in Nyasaland. Keys are given to the males and females of these species, *R. compositus* Neum. and *R. longus* Neum., which resemble one another in many respects. The differentiation of *R. gertrudae* from *R. capensis* is likely to elucidate ecological observations that have hitherto seemed confusing [*R.A.E.*, B **40** 170].

CAMIN (J. H.) & EHRLICH (P. R.). **A cage for maintaining stock colonies of parasitic mites and their hosts.**—*J. Parasit.* **46** no. 1 pp. 109–111, 2 figs., 1 ref. Lancaster, Pa., 1960.

A method of rearing parasitic mites is described that allows of the routine removal of the excrement of the host without loss of a large proportion of the mites. The apparatus used consists of a three-sided cage within a cylindrical one. The inner cage, which holds the host, has walls, 9 in. long, of hardware cloth on a metal frame and is open at the top and bottom. A lid of similar construction hooks over it, and a triangular pan fitting into its base serves as a receptacle for faeces and urine, which drop into it through a hardware-cloth floor resting on stops welded on to the inner walls of the pan. The floor and pan can be lifted out as a unit. The outer cage is a galvanised metal can 11 in. in diameter and 8 in. high with a moat 2 in. from the upper edge projecting 1 in. above it. The moat is filled with water, and a lid, with two screened openings for ventilation and a small hole through which the tube of a watering bottle may be inserted, is fitted over it. The tube must be greased to prevent the escape of mites. The spaces between the inner and outer cages are filled with nesting material (shredded paper, corrugated cardboard or wood shavings), and mites such as *Dermanyssus gallinae* (Deg.) and *Laelaps* (*Echinolaelaps*) *echidninus* Berl. spend most of their time in this and visit the host only to feed. The host is periodically removed, and the floor and pan are lifted through the triangular cage, cleaned and replaced, with the loss of very few mites.

WOOD (J. C.), SPARROW (W. B.), PAGE (K. W.) & BROWN (P. R. M.). **The use of dieldrin, aldrin and Delnav for the control of the sheep tick,** *Ixodes ricinus*.—*Vet. Rec.* **72** no. 6 pp. 98–101, 1 ref. London, 1960.

The effectiveness of dips containing aldrin, dieldrin or Delnav (2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)) against *Ixodes ricinus* (L.) on sheep was tested in the counties of Northumberland, Selkirk and Dumfries in 1952–59 in comparison with a commercial dip containing γ BHC. Sheep were dipped in early April, a few days before the first lambs were due, and the effectiveness of a formulation, termed percentage protection, was evaluated by expressing the difference between the numbers of adult female ticks attached to the face, ears and axillae of treated and untreated animals as a percentage of the numbers on the untreated ones. Seven and (in brackets) 14 days after treatment, dips containing 0·06 per cent. γ BHC and dieldrin suspension or emulsion gave, respectively, 79·3 (82·1), 20 (30·3) and 2·3 (28·5) per cent. protection; aldrin at 0·3 per cent. gave 43·5 (0) per cent., and dieldrin suspensions at 0·58 per cent., 54·5 (82·4) per cent. It was found that dips containing 0·1 per cent. Delnav gave good protection for 5–6 weeks compared with 2–3 weeks' protection given by dips containing a similar amount of γ BHC. Poor protection was obtained on sheep sprayed lightly with 0·25 per cent. Delnav.

BURGDORFER (W.). **The possible role of ticks as vectors of leptospirae. II. Infection of the Ixodid ticks,** *Dermacentor andersoni* **and** *Amblyomma maculatum*, **with** *Leptospira pomona*.—*Exp. Parasit.* **8** no. 5 pp. 502–508, 1 fig., 9 refs. New York, N. Y., 1959.

In the experiments described in this second paper of a series [*cf. R.A.E.*, B **46** 180], adults of laboratory strains of *Dermacentor andersoni* Stiles and

Amblyomma maculatum Koch acquired infection when allowed to feed on a heavy suspension of *Leptospira pomona* of the strain isolated from pigs in Illinois in 1953 [*cf.* **46** 181]; some of the ticks, representing both species, subsequently transmitted *L. pomona* to weanling guineapigs. The leptospiras penetrated the gut wall and infected the salivary glands, central ganglion and genital system of the ticks, but could not be detected in developing egg follicles. However, attempts to infect nymphs and adults of both species by feeding them on infected hamsters were unsuccessful. Since infection with *L. pomona* is usually much less intense in pigs and other domestic animals than in hamsters, it seems unlikely that *D. andersoni* or *A. maculatum* would transmit *L. pomona* from the former.

Welch (H. E.). **Two applications of a method of determining the error of population estimates of mosquito larvae by the mark and recapture technique.**—*Ecology* **41** no. 1 pp. 228–229, 2 refs. Brooklyn, N. Y., 1960.

A method of determining the error in estimates of populations of mosquito larvae made by the marking, release and recapture technique [*cf. R.A.E.*, B **28** 140, etc.] is described. Using it, the author confirmed the decrease in numbers recorded earlier [**45** 95] in observations in a permanent pool in Ontario, and compared the density of larvae in a temporary pool, also in Ontario, with that in the former. Population estimates in the temporary pool were made on three days in April 1954. The results showed that larval density was higher in the temporary than in the permanent pool but decreased similarly with time in both. Errors were proportionately greater in the case of the temporary than in that of the permanent pool, probably because of greater variation in depth and length of shoreline and consequent irregularity in the distribution of introduced larvae. Large error was associated with low recovery ratio. The proportion of marked larvae in the total number caught was sometimes as much as ten times as high in the permanent as in the temporary pool. The technique and analysis are easy to use in the field, but a large number of larvae should be marked and as many recovery samples as possible taken, and the experiment must be short, so that natural mortality can be disregarded.

PAPERS NOTICED BY TITLE ONLY.

Doby (J. M.), Rault (B.) & David (F.). *Theobaldia* [*Culiseta*] (*Culicella*) *litorea* (**Shute 1928**) **et** *Anopheles* (*Anopheles*) *algeriensis* **Théobald 1903, dans l'ouest de la France. Contribution à l'étude écologique de ces deux espèces.**—*Ann. Parasit. hum. comp.* **35** no. 1–2 pp. 174–187, 6 figs., 28 refs. Paris, 1960.

Peterson (B. V.) & Davies (D. M.). **Observations on some insect predators of black flies (Diptera: Simuliidae) of Algonquin Park, Ontario.**—*Canad. J. Zool.* **38** no. 1 pp. 9–18, 30 refs. Ottawa, 1960.

Peterson (B. V.). **Notes on some natural enemies of Utah black flies (Diptera: Simuliidae).**—*Canad. Ent.* **92** no. 4 pp. 266–274, 6 figs., 25 refs. Ottawa, 1960.

Norris (K. R.). **The ecology of sheep blowflies in Australia.**—[*In*] Keast (A.), Crocker (R. L.) & Christian (C. S.). Ed. **Biogeography and ecology in Australia.**—*Monogr. biol.* **8** pp. 514–544, 3 graphs, 48 refs. The Hague, W. Junk, 1959.

BOORMAN (J. P. T.) & SERVICE (M. W.). **Some records of mosquitoes (Culicidae Diptera) from the Niger Delta area, Southern Nigeria.**—*W. Afr. med. J.* (N.S.) **9** no. 2 pp. 67–72, 8 refs. Ibadan, 1960.

The results are given of a survey of a small area of the Niger Delta, Southern Nigeria, in April 1959, during which 46 species of mosquitos were taken. The habitats of the principal species and their possible importance in the local transmission of disease are briefly discussed. Immature stages of seven species of *Anopheles* were found, mainly in ditches; five females of *A. coustani* var. *ziemanni* Grünb. were caught coming to bite man, and 27 adults of *A. gambiae* Giles were taken, 19 in early-morning catches in houses and eight in houses during the night. *A. gambiae* was found breeding in the forest as well as in the village compounds and is probably the most important malaria vector locally. *A. funestus* Giles was found only occasionally, in ditches and streams beyond the compounds. *Mansonia africana* (Theo.) was the commonest species taken biting; its immature stages were associated with *Pistia stratiotes*, which was brought down the river in large masses. *Aëdes africanus* (Theo.), typically an arboreal species [*R.A.E.*, B **37** 177], was taken biting at ground level in the villages and also occurred in houses. Immature stages of *A. aegypti* (L.) were represented in collections from tree holes but were not found in domestic or artificial containers, though plenty of these were available. It appeared to be comparatively rare in the area.

ESSLINGER (J. H.) & CHANDLER (A. C.). **Studies on the properties of the metabolic products of the screw-worm,** *Callitroga hominivorax* **(Coquerel).**—*Exp. Parasit.* **8** (1959) no. 6 pp. 527–538, 5 figs., 13 refs. New York, N. Y., 1960.

The following is virtually the authors' summary of the results of work carried out in a laboratory in Texas. Metabolic products of developing larvae of *Callitroga hominivorax* (Coq.) were collected in the form of exudate, sterilised by filtration, from the lesions of infested guineapigs and as the liquefied portions of an *in vitro* medium consisting of fresh guineapig muscle and blood in which larvae had been cultivated under axenic conditions. These products, when injected intraperitoneally into guineapigs and mice, produced severe anaphylactoid reactions and sometimes death. They also contained a spreading factor and produced marked erythematous thickening of the skin with proliferation of fibrous tissue when injected intracutaneously. *In vitro*, they showed proteolytic, haemolytic and anticoagulating properties. The possible sources and identities of the active substances are discussed.

STEVE (P. C.). **Biology and control of the little house fly,** *Fannia canicularis*, **in Massachusetts.**—*J. econ. Ent.* **53** no. 6 pp. 999–1004, 4 figs., 13 refs. Menasha, Wis., 1960.

As the annoyance caused by heavy populations of *Fannia canicularis* (L.) on poultry farms in Massachusetts has become a serious problem, the bionomics and control of this fly were investigated. The following is mainly based on the author's summary of the work.

The larvae were reared in the laboratory in CSMA medium [*cf. R.A.E.*, B **44** 25, etc.] that had been nearly saturated with a 20 per cent. molasses solution containing one yeast cake per 1,000 ml. At 80°F. and 65 per cent. relative humidity, the egg, larval and pupal stages lasted about 1½–2, 8–10 and 9–10 days, respectively [*cf.* **43** 193], and development from egg to egg took 22–27 days; under the same conditions, half the males died within 14 days of emergence, with some living for up to 28 days, and half the females within 24 days, with a few living for 54. The sexes emerged in equal proportions. Females oviposited more readily in the droppings of a fowl than in the faeces of a pig, horse, cow or sheep, possibly being attracted by the high ammonia content of fowl droppings. Adults were unable to fly against air currents exceeding 16 miles per hour.

Infestations of *F. canicularis* were heavier on poultry farms in which fowl droppings were collected and allowed to accumulate in pits underneath the roosts than on those in which droppings fell on to litter maintained in a dry condition on the open floor. More than half the farms inspected employed the pit system of collecting droppings. All stages except the egg were found during the winter, third-instar larvae and pupae predominating. Adults became active in early March and were present in large numbers throughout the summer and until mid-October; they were also present in houses near poultry farms throughout the year except for three weeks in February. Impregnated cotton cords containing 13·79 per cent. parathion and 3·54 per cent. diazinon, installed at the rate of 300 ft. of cord per 1,000 sq. ft. of floor area, gave excellent control on three poultry farms for the whole season [*cf.* **48** 19].

Gordon (H. T.) & Eldefrawi (M. E.). **Analog-synergism of several carbamate insecticides.**—*J. econ. Ent.* **53** no. 6 pp. 1004–1009, 16 refs. Menasha, Wis., 1960.

Dimetilan (3-methyl-5-pyrazolyl dimethylcarbamate) has been shown to be 20 times as toxic as Pyrolan or Sevin to *Musca domestica* L., though a much weaker inhibitor of fly-head cholinesterase *in vitro*. In tests in which this compound, Isolan, Sevin and Pyrolan, alone and in pairs, were applied topically in acetone to females of a susceptible strain of *M. domestica*, it was the most toxic, followed by Isolan; it showed synergism with Sevin and Pyrolan, which were relatively non-toxic alone, but this was weak unless a quantity of Dimetilan sufficient to give considerable mortality alone was used. Isolan showed little synergism with Sevin and some antagonism with Pyrolan, and synergism was also shown by Sevin with Pyrolan. The condition for effective synergism among these analogues was apparently the combination of the LD50 of a moderately toxic, slowly detoxified analogue (the synergist) with an equivalent or somewhat lower dosage of a potentially much more toxic but rapidly detoxified one. Further synergism was shown when 0·2 μg. sesamex per insect was added to 1:1 mixtures of Dimetilan and Sevin [*cf. R.A.E.*, B **49** 102] but not at lower dosages.

In tests with the same materials, males of *Blattella germanica* (L.) showed similar reactions, though they were much less susceptible to the carbamates than was *M. domestica*. Isolan was the most effective, and Sevin and Pyrolan non-toxic alone but moderately toxic when sesamex was added. Doses of Isolan or Dimetilan between the LD20 and LD50 were strongly synergistic with either Sevin or Pyrolan, and a 1:1 mixture of Isolan and Sevin was further synergised by sesamex.

It is suggested that these species may possess a detoxifying " carbamate esterase " that destroys some carbamate insecticides, and that partial inhibition of this by Dimetilan, which is broken down slowly, accounts for the synergistic action of the latter with other carbamates that are broken down more easily. Tests with nymphs of *Oncopeltus fasciatus* (Dall.), to which the carbamates were not very toxic, indicated that this bug possesses little carbamate esterase.

VICKERY (D. S.) & ARTHUR (B. W.). **Animal systemic activity, metabolism, and stability of Co-Ral (Bayer 21/199).**—*J. econ. Ent.* **53** no. 6 pp. 1037–1043, 3 figs., 25 refs. Menasha, Wis., 1960.

Studies were made of the toxicity of coumaphos (Co-Ral) and related derivatives to insects and mammals, their effectiveness as systemic insecticides, and the absorption, excretion and metabolism of radioactive coumaphos by insects and mammals. Nymphs of *Cimex lectularius* L. and *Amblyomma maculatum* Koch were allowed to feed on rabbits that had been treated orally or dermally with coumaphos or Potasan, or subcutaneously or intramuscularly with coumaphos. Neither material was effective against *A. maculatum*, but, when applied dermally at a rate of 200 mg. per kg. body weight, both caused complete mortality of *C. lectularius*. The relative toxicities of coumaphos, its oxygen analogue [diethyl 3-chloro-4-methyl-7-coumarinyl phosphate], chloroferron (3-chloro-4-methyl-7-hydroxycoumarin) and Potasan were estimated by comparing the LD50's obtained when females of *Musca domestica* L. and adults of *C. lectularius* were treated topically with acetone solutions of the compounds, when fourth-instar larvae of *Aëdes aegypti* (L.) were introduced into water containing the insecticides, and when rats were treated orally or subcutaneously with the insecticides in 1:1 mixtures of maize oil and acetone. Coumaphos and its oxygen analogue were about equally toxic to *M. domestica* [*cf. R.A.E.*, B **48** 193], and three times as toxic as Potasan. The oxygen analogue was less toxic to *C. lectularius* than either coumaphos or Potasan, of which the latter was less toxic than the former. Coumaphos was 16 and 26 times as toxic to *A. aegypti* as its oxygen analogue and Potasan, respectively. Chloroferron was not toxic at the dosages tested. The acute oral LD50 of coumaphos and Potasan to rats was 20 mg. per kg. body weight. Coumaphos was considerably less toxic, and when administered subcutaneously the oxygen analogue was about twice as toxic. No toxic symptoms were noted in rats treated dermally with coumaphos at 40, 100 or 500 mg. per kg. body weight or in rabbits injected with 40 mg. subcutaneously or 50 mg. intramuscularly, but one rabbit out of three to which technical coumaphos was applied dermally at 500 mg. died.

The fate of coumaphos labelled with ^{32}P was studied in *M. domestica*, *Blattella germanica* (L.) and *Stomoxys calcitrans* (L.) treated topically at a rate of 50 mg. per kg. body weight, and in rats and rabbits treated orally with the compound mixed with maize oil and acetone at 10 mg. per kg. body weight. The metabolites recovered from the insects and the mammals were the oxygen analogue of coumaphos, ethyl and diethyl phosphoric acid, O,O-diethyl phosphorothioic acid and possibly "desethyl" coumaphos [O-ethyl O-3-chloro-4-methyl-7-coumarinyl phosphorothioate], though different amounts of each metabolite were formed. Only 3–6 per cent. of the radioactive compound administered orally or dermally to rats was recovered in the excreta as unchanged coumaphos, the oxygen analogue or other chloroform-soluble metabolites, whereas 90 per cent. of the dose absorbed by *B. germanica* and 75 per cent. of that absorbed by *M. domestica* were recovered as coumaphos or chloroform-soluble materials. The remaining radioactive materials in rat excreta, cockroaches or house-flies were recovered as water-soluble products. The ability of rats to degrade coumaphos to water-soluble products more rapidly than insects is probably a significant factor in determining the selective toxicity of coumaphos [*cf.* **47** 104; **48** 163, 195]. The activation of coumaphos to a more potent anticholinesterase agent (the oxygen analogue [*cf.* **48** 194]), was demonstrated *in vitro* using rat liver slices; both activating and degrading systems were present in rat liver. Coumaphos was quite stable in the presence of the esterases of human serum, degradation after eight hours' incubation being less than 10 per cent.

Chattoraj (A. N.) & Brown (A. W. A.). **Internal DDE production by normal and DDT-resistant larvae of** *Aedes aegypti*.—*J. econ. Ent.* **53** no. 6 pp. 1049–1051, 11 refs. Menasha, Wis., 1960.

The following is substantially the authors' summary. Third- and fourth-instar larvae of three strains of *Aëdes aegypti* (L.) susceptible to DDT produced about one-sixth as much DDE as did larvae of three DDT-resistant strains when all were exposed to 1 part DDT per million for 24 hours, but DDE production was roughly proportional to the duration and percentage of survival. In another strain that was naturally tolerant to DDT, and in which the levels of susceptibility to DDT were varied by subjection to, or relaxation of, pressure, there was little relation between the changes in susceptibility and the rate of DDE production.

Wrich (M. J.) & Bushland (R. C.). **Screw-worm control with insecticide sprays.**—*J. econ. Ent.* **53** no. 6 pp. 1058–1061, 5 refs. Menasha, Wis., 1960.

As sprays of Bayer 22408 (O,O-diethyl O-napthalimido phosphorothioate) gave excellent control of larvae of *Callitroga hominivorax* (Coq.) in preliminary laboratory tests with artificially infested sheep, its effectiveness against the larvae on sheep, goats and cattle was compared with that of coumaphos (Co-Ral) in 0·5 or 0·25 per cent. sprays in field tests on seven farms in south-western Texas in 1959; on three of the farms, a few cattle were treated with EQ-335 [a wound dressing containing γ BHC (*cf. R.A.E.*, B **47** 139)]. The first two materials gave good control of *C. hominivorax*, except on cattle on two farms subjected to heavy attack, being equally effective and superior to EQ-335. As Bayer 22408 had failed to effect control on some of the cattle, further laboratory tests were carried out with artificially infested sheep and yearling cattle. The sheep were sprayed with 0·1–1 per cent. Bayer 22408 or 0·25 per cent. coumaphos. After 24 hours, all treatments gave complete kill of larvae that were two days old, but some that were three days old survived. The cattle were sprayed with 0·1, 0·25 or 0·5 per cent. Bayer 22408 at 1·5 U.S. gal. per animal, which gave thorough wetting; only the highest concentration killed the larvae of all ages (1–3 days old), but the establishment of larvae transferred to the wounds on the following day was not prevented; earlier field tests had shown that thorough spraying of cattle with 0·25 per cent. coumaphos killed all three ages of larvae and gave at least two days protection.

Sherman (M.) & Ross (E.). **Toxicity to house fly larvae of droppings from chicks given Dipterex-treated water.**—*J. econ. Ent.* **53** no. 6 pp. 1066–1070, 3 figs., 9 refs. Menasha, Wis., 1960.

The following is substantially the authors' summary of the results of investigations carried out in Hawaii on the toxicity to newly-hatched larvae of *Musca domestica* L. of droppings from chicks given water treated with trichlorphon (Dipterex), a mode of administration that allows easier preparation, more accurate admixture and greater flexibility than does incorporation of the compound into the feed [*R.A.E.*, B **49** 119, etc.]. The pH of the water used for the trichlorphon solutions affected the results, solutions of pH 8 causing a rapid decrease in the toxicity of the droppings. Trichlorphon at 30 parts per million in distilled water, or water acidified with hydrochloric acid, caused high mortality of larvae in the droppings. At this concentration, no adverse effect on gain in weight, consumption of water or conversion of feed was observed in the chicks. It seems that, under these conditions, the chicks metabolise trichlorphon and excrete a highly larvicidal product, but when, under alkaline conditions, trichlorphon is converted to dichlorvos (DDVP) [*cf.* **48** 93], metabolism takes a different course and the products have low larvicidal activity.

Mulla (M. S.). **Organophosphorus and carbamate insecticides as soil treatments against the eye gnat,** *Hippelates collusor*, **in the laboratory.**—*J. econ. Ent.* **53** no. 6 pp. 1102–1107, 2 figs., 7 refs. Menasha, Wis., 1960.

Preliminary evaluations were made in the laboratory of the effectiveness of 24 organophosphorus compounds, three carbamates and Thiodan as soil treatments for the control of *Hippelates collusor* (Tns.), eggs of which were added to samples of sprayed soil and organic matter, the emerging adults being counted and removed at intervals [*cf. R.A.E.*, B **49** 117]. The following is substantially the author's summary of the results. Of the organophosphates, coumaphos (Co-Ral), Bayer 25141 (O,O-diethyl O-p-methylsulphinylphenyl phosphorothioate), Experimental Nematocide 18133 (O,O-diethyl O-2-pyrazinyl phosphorothioate), fenthion (Bayer 29493), GC-4072 (diethyl 2-chloro-1-(2,4-dichlorophenyl)vinyl phosphate), azinphos-ethyl (Ethyl Guthion), Trithion, GC-3582 (diethyl 1-(2,5-dichlorophenyl)-2,2-dichlorovinyl phosphate), fenchlorphos (ronnel), G-30494 (O,O-dimethyl S-2,5-dichlorophenylthiomethyl phosphorodithioate), phorate, Bayer 22408 (O,O-diethyl O-naphthalimido phosphorothioate), Methyl Trithion (O,O-dimethyl S-p-chlorophenylthiomethyl phosphorodithioate), GC-3583 (diethyl 1-(2,5-dichlorophenyl)-2-chlorovinyl phosphate), ethion, azinphos-methyl (Guthion), Di-Syston (O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate) and Delnav (2,3-p-dioxane S,S-bis(O,O-diethyl phosphorodithioate)) showed high initial toxicity; the first four were the most effective, causing almost complete elimination of emerging adults at rates of 0·1, 0·2, 0·5 and 0·2 lb. per 6-in. acre, respectively, and Di-Syston and Delnav were the least so, causing, respectively, 92 and 97 per cent. reduction at 2 lb. per 6-in. acre. The dosages of dimethoate and parathion required to cause 90 per cent. reduction were 4·8 and 5 lb. per 6-in. acre, respectively. Dicapthon and Am. Cyanamid 18706 (O,O-dimethyl S-ethylcarbamoylmethyl phosphorodithioate) at 16 lb., trichlorphon (Dylox) at 30 lb., and phosphamidon at 24 lb. per 6-in. acre, respectively, gave percentage reductions of emerging adults of 57, 70, 54 and 72. Thiodan was ineffective at practical dosages [*cf.* **49** 117]. Of the carbamates, AC-5727 (m-isopropylphenyl methylcarbamate) was the most effective, giving 89 per cent. reduction at 10 lb. per 6-in. acre, Sevin was effective only at higher dosages, causing 91 and 100 per cent. reductions at 20 and 30 lb., respectively, and m-tert.-butylphenyl methylcarbamate showed no appreciable activity at 10 and 20 lb. per 6-in. acre.

Smith (C. L.). **Mass production of screw-worms** (*Callitroga hominivorax*) **for the eradication program in the southeastern states.**—*J. econ. Ent.* **53** no. 6 pp. 1110–1116, 3 graphs, 5 refs. Menasha, Wis., 1960.

Procedures, based on previously developed methods [*R.A.E.*, B **49** 11, etc.], are described by which a minimum of 50,000,000 adults of *Callitroga hominivorax* (Coq.) were bred weekly in Florida in 1958–59 for sterilisation and field release. The stock colony was kept in cages of aluminium screen and metal, 71 × 42 × 42¾ in., set up in a rotating schedule so that during each 8-hour shift two cages were stocked with pupae, six litres in each, two were separated for oviposition and two were removed to a chilling room kept at 34–40°F., where the eggs were removed and the other contents destroyed. Oviposition was induced by introducing into the cages, each then containing about 60,000 flies eight days old, an electrically heated tray, 66 × 12 × 2 in., containing 0·5–0·75 in. ground lean horse meat mixed with an attractant fluid extracted from incubated ground ox heart or blood albumin; the temperature of this oviposition medium was maintained at 98–102°F. by lamps, the light of which also helped to attract the flies, and oviposition was completed in about four hours. Larvae were reared in a medium of ground horse or whale meat in vats, which they left when full-grown, crawling to the edge and falling on to sand in trays on moving racks; they pupated in the sand from which the pupae were separated, at 8-hour intervals, placed in wire trays, maintained at 80°F. and 70–80 per cent. relative humidity for about 5½ days, and then removed for irradiation or return to the stock colony, which required the diversion of about 5 per cent. of the resulting pupae for its maintenance. By these means, slightly more than 3,800,000,000 pupae were produced between January 1958 and October 1959, and the release of male flies sterilised by irradiation eradicated *Callitroga* from Florida [*cf.* **44** 104].

LEWALLEN (L. L.). **On the stability of insecticide-resistance in mosquitoes.** —*J. econ. Ent.* **53** no. 6 pp. 1122–1124, 10 refs. Menasha, Wis., 1960.

Laboratory tests were conducted in California in 1959 to determine the stability of the resistance of mosquito larvae to chlorinated-hydrocarbon and organophosphorus insecticides. It was found that a strain of *Culex pipiens fatigans* Wied. (*quinquefasciatus*, auct.) that was initially 165 times as resistant to DDT as a susceptible laboratory strain at the LC50 level was only 14·5 times as resistant after being maintained for about six months without selection with the insecticide. Similar tests with fourth-instar larvae of a parathion-resistant strain of *Aëdes nigromaculis* (Ludl.) [*cf. R.A.E.*, B **49** 138] and a malathion-resistant strain of *C. tarsalis* Coq. [**47** 198] showed a decline in resistance of field populations from the previous year. In *C. tarsalis*, malathion resistance that had been at a fairly high level in 1956–58 had decreased in 1959 to the level of a susceptible laboratory strain, in spite of continued use of malathion in the field, and when the larvae were exposed to DDT their response was comparable to that of the susceptible strain, although malathion had been used originally because resistance to chlorinated hydrocarbons had developed. The decline of resistance in *A. nigromaculis* from 68 times the normal in 1958 to a maximum of 24 times the normal during 1959 may have been due to fewer treatments and to the substitution of Metacide (60 per cent. methyl-parathion and 15 per cent. parathion) for parathion. Where cross-resistance does not exist, rotational application of organophosphorus insecticides with other compounds with different modes of action is suggested as a means of averting the development of resistance. Prolonged and frequent use of any one insecticide should be avoided against insects with a high biotic potential, such as mosquitos.

DRUMMOND (R. O.). **Preliminary evaluation of animal systemic insecticides.** —*J. econ. Ent.* **53** no. 6 pp. 1125–1127, 3 refs. Menasha, Wis., 1960.

In preliminary laboratory tests, 17 organophosphorus compounds exhibited systemic insecticidal activity when administered orally or subcutaneously to guineapigs infested with nymphs of *Amblyomma americanum* (L.) or newly hatched larvae of *Callitroga hominivorax* (Coq.), or on which adults of *Stomoxys calcitrans* (L.) were allowed to feed [*cf. R.A.E.*, B **47** 163]. Further tests were therefore undertaken to evaluate their effectiveness and that of Bayer 23129 (O,O-dimethyl S-2(ethylthio)ethyl phosphorodithioate) against larvae of *Hypoderma lineatum* (Vill.) and *H. bovis* (Deg.) on cattle from the northern United States and of the first species on cattle from Texas. Fenthion (Bayer 29493) and Stauffer R-2371 (O,O-diethyl S-di(p-chlorophenyl)methyl phosphorodithioate) administered in capsules at rates of 25 and 75 mg. per kg. body weight, respectively, and the first as a 0·5 per cent. spray, gave complete control, and Dowco 105 (O-methyl O-4-tert.-butyl-2-chlorophenyl ethylphosphoramidothioate) as a drench at 50 mg. per kg. body weight gave 97 per cent. The other 15 compounds were ineffective, inconsistently effective, or effective only at dosages toxic to the cattle.

DODGE (H. R.). **An effective, economical flytrap.**—*J. econ. Ent.* **53** no. 6 pp. 1131–1132, 1 fig., 2 refs. Menasha, Wis., 1960.

The trap described, which is for use against filth flies and has been tested for several seasons, consists of a wire-rimmed cardboard carton, 9 in. in diameter, into the open bottom of which a screen cone with a hole in the top is inserted, and to the basal rim of which a strip of ½-in. mesh hardware cloth, 2 in. wide, is soldered to serve as its base. The top of the trap is covered with transparent plastic held in place by a rubber band. It may be rendered more weatherproof by painting the cardboard with aluminium paint. In operation, the trap is placed over a suitable bait, and stones are propped against the base to protect it against wind and molestation by small animals. If desired, the inner walls may be coated with an insecticide.

CHAMBERLAIN (W. F.) & HOPKINS (D. E.). **Effect of colchicine on screwworms.**—*J. econ. Ent.* **53** no. 6 pp. 1133–1134, 2 refs. Menasha, Wis., 1960.

In laboratory tests on the effect of colchicine on *Callitroga hominivorax* (Coq.), acetone solutions of the chemical were added to the larval medium [*R.A.E.*, B **29** 132], and the adults were provided with honey and water. Newly emerged adults of one sex were allowed to pair with treated or untreated flies of the other, the females were confined in vials containing freshly ground beef three times during the 7–14 days that elapsed after emergence, and the eggs produced were kept on moist paper at 35°C. [95°F.] for 24 hours. Preliminary tests showed that whereas colchicine at a concentration of 0·0005 per cent. killed all newly hatched larvae in 48 hours, it could be used at 0·00025 per cent. without causing appreciable mortality, although it killed larvae two days old. At 0·0001 per cent., it caused no larval mortality but adult emergence was reduced when larvae of all three instars, or of the third instar only, were treated, though not when treatment was confined to the first and second instars. At 0·0002 per cent., colchicine caused high larval mortality when all three larval instars, or the last only, were treated, but there was no effect on larval mortality or adult emergence when only first and second instars were treated. It is suggested that the toxicity of colchicine to third-instar larvae is related to the faster rate of development of the sex organs during the third instar than during the first or second. There was only a slight reduction in viability of eggs, and no consistent difference between the effects on the fertility of males or females, or between flies from larvae treated in their first and second instars or from larvae treated only in their third instar. Microscopic examination of the sex organs of flies, four and eight days old, that had been treated as first- and second-instar larvae with 0·0002 per cent. colchicine showed that the ovaries were less than one-third normal size [*cf.* **46** 117] and that degeneration of the testes had occurred; these effects seemed to be related to the reduction in egg viability.

GREEN (H. B.) & HUTCHINS (R. E.). **Laboratory study of toxicity of imported fire ants to bluegill fish.**—*J. econ. Ent.* **53** no. 6 pp. 1137–1138, 1 fig., 1 ref. Menasha, Wis., 1960.

The death of bluegill bream, *Lepomis* sp., in farm ponds in southern Mississippi and Alabama was associated with the presence of large numbers of *Solenopsis saevissima richteri* Forel in the stomachs of the fish. In laboratory tests, the fish did not seem to eat the ants readily, but when ants macerated in water were pumped into their stomachs, they showed symptoms of poisoning within five minutes and died in about 45 minutes.

BURDEN (G. S.), LOFGREN (C. S.) & SMITH (C. N.). **Development of chlordane and malathion resistance in the German cockroach.**—*J. econ. Ent.* **53** no. 6 pp. 1138–1139, 4 refs. Menasha, Wis., 1960.

The development of resistance to malathion in *Blattella germanica* (L.) has been demonstrated in the laboratory [*R.A.E.*, B **47** 152; **49** 101], and experiments were undertaken in 1956 to determine whether it could be prevented or retarded by the alternate or combined use of malathion and chlordane. Four experimental colonies were formed by exposing nymphs of each generation of a susceptible laboratory colony to contact sprays in deodorised kerosene in a wind tunnel, the concentrations being selected to cause about 50–75 per cent. mortality. The colonies were treated with chlordane, malathion, a combination of chlordane and malathion, or chlordane and malathion alternately in successive generations. The development of resistance in them was determined by exposing continuously adult males of each generation, derived from nymphs that had not been exposed to the toxicant, on deposits of 10 mg. chlordane or malathion per sq. ft. in glass jars and recording the time required for 50 or 90 per cent. kill or knockdown (LT50 or LT90). The degree of resistance was estimated as the ratio of the LT50's and LT90's of each experimental colony to those of the original susceptible colony. The results indicated that resistance to chlordane developed as rapidly in the colony selected with chlordane and malathion alternately as in that selected with a combination of the two, and almost as rapidly as in that selected with chlordane alone; these colonies attained 20-, 21- and 26-fold resistance, respectively, in the F_6 generations. The colonies selected with both insecticides, alternately or in combination, developed resistance to malathion at almost the same rate, with 2- to 5-fold resistance in the F_6–F_{14} generations. The colony selected with malathion developed 3- to 11-fold resistance to malathion in the F_4–F_{14} generations, and 2- to 3-fold cross-resistance to chlordane in the F_{12}–F_{14} generations. The colony selected with chlordane alone did not develop resistance to malathion. The results indicated that the alternate or combined application of chlordane and malathion slightly retarded, but did not prevent, the development of resistance to these compounds.

THOMAS (W. P.). **Notes on a preliminary investigation into the habits and life cycle of** *Copris incertus* **Say (Coprini: Coleoptera) in New Zealand.**—*N. Z. J. Sci.* **3** no. 1 pp. 8–14, 4 figs., 4 refs. Wellington, N. Z., 1960.

The following is virtually the author's summary. The habits and life-cycle of the introduced beetle, *Copris incertus* Say, were studied to ascertain its possibilities as an agent in the control of noxious species of flies, its probable rate of development, and chances of establishment and spread in New Zealand. This species, which is of Mexican origin, was introduced into New Zealand from Western Samoa, where it plays a significant part in the reduction of flies by removal, in part, of the animal droppings in which flies breed [*cf. R.A.E.*, B **29** 57], and released in two areas. In New Zealand, the fly most likely to be reduced in this manner is *Sarcophaga milleri* Johnston & Tiegs, which is probably not of primary importance either to stock or to human health. The relative importance and relevant habits of the more important flies are discussed. Duration of life-cycle under controlled and insectary conditions indicates that in New Zealand *C. incertus* is not likely to multiply fast enough to have any significant effect on fly populations. Development from egg to adult at 75°F. occupied approximately 62 days.

BAR-ZEEV (M.). **The reaction of mosquitoes to moisture and high humidity.**—*Ent. exp. appl.* **3** no. 3 pp. 198–211, 1 fig., 34 refs. Amsterdam, 1960. (With a summary in French.)

The following is substantially the author's summary. A method is described by which the effect of a wet surface and the air close to it (up to a height of 2 cm.) on females of *Aëdes aegypti* (L.) could be determined. The insects were placed in a petri dish, under controlled conditions of temperature and humidity. The bottom of the dish was lined with two semicircular filter papers, one of which was kept dry and the other wet. The intensity of the response was determined as the mean excess percentage of position records on the dry and wet sides. Female mosquitos avoided very strongly a wet surface and moderately the air close to it. Mosquitos did not feed on a human arm as long as the skin was kept wet. Desiccated mosquitos (showing a water loss of 5·6 per cent. or more of their weight) were strongly attracted to a wet surface and moderately to the air close to it. The higher the desiccation, the stronger was the attraction. Gravid females moderately avoided a wet surface, but gave no reaction to the air close to it. There is some evidence that gravid mosquitos must be in a ' laying state ' before attraction to a wet surface occurs. The higher the ambient air humidity, the stronger the avoidance of a wet surface and of the air close to it. High and low ambient temperatures (35 and 18°C. [95 and 64·4°F.]) elicited a weaker response to dry conditions than a medium temperature (28°C. [82·4°F.]). The causes of the contradictory results obtained by various investigators reporting the response of mosquitos to moisture are discussed. The differences are most probably due to differences in the techniques used and in the physiological state of the mosquitos. The avoidance of a wet region is due to a taxis and not to a kinesis.

BARRASS (R.). **The ecology of the female** *Haematopota insidiatrix* **Austen (Diptera, Tabanidae) in Southern Rhodesia.**—*Ent. exp. appl.* **3** no. 3 pp. 212–221, 7 figs., 17 refs. Amsterdam, 1960. (With a summary in German.)

The observations here recorded on the ecology of *Haematopota insidiatrix* Aust. were made in the hot climate of Wankie National Park, Southern

Rhodesia, in January and December 1959 and January 1960. Activity was judged by the number that settled on black cloth screens carried through the bush. Only the blood-sucking females settled, and only these were studied. Many were caught in woodland composed of *Acacia giraffae* and of *Terminalia* and *Baikiaea*, and few among small trees or when crossing grass. The flies settled on the screen over a wide range of conditions. The lowest temperature at which they were caught was 14·7°C. [58·46°F.]. The highest catch was made in the early morning in calm, humid, hot, sunny weather. Very high temperatures and low humidity were associated with low catches, and there seemed to be a morning peak of activity on hot, sunny days. Cloud obscuring the sun, or a gust of wind, reduced catches, but did not completely suppress activity. Adults were observed flying round a motor vehicle during a heavy rainstorm.

Johnson (C. G.). **The relation of weight of food ingested to increase in body-weight during growth in the bed-bug,** *Cimex lectularius* **L. (Hemiptera)**.—*Ent. exp. appl.* **3** no. 3 pp. 238–240, 4 refs. Amsterdam, 1960. (With a summary in German.) **Erratum.**— *Op. cit.* **4** no. 2 p. 132. 1961.

The following is based on the author's summary. Investigations on *Cimex lectularius* L. showed that the increase in the body weight before feeding of successive instars is of the order of 30 per cent. of the weight of the blood ingested in each instar, except in the first and second instars, in which it is about 40 per cent. There is a characteristic trend in the efficiency with which the blood is used to increase body weight from instar to instar, and the mean value per instar for different hosts is positively related to the proportion of solid matter in the blood. Efficiency does not vary appreciably with temperature between 20 and 30°C. [68 and 86°F.].

Bar-Zeev (M.). **The location of hygroreceptors and moisture receptors in** *Aedes aegypti* **(L.)**.—*Ent. exp. appl.* **3** no. 3 pp. 251–256, 20 refs. Amsterdam, 1960. (With a summary in French.)

The following is substantially the author's summary of the results of the investigations described. Hygroreceptors that mediate dry or wet reactions in *Aëdes aegypti* (L.) are situated on the antennae, and moisture receptors that mediate similar reactions are situated on the tarsi; the palps do not seem to possess hygroreceptors. When the tarsi were removed, the response to moisture differed from that of intact mosquitos or of mosquitos of which the tarsi were covered. Activity was considerably reduced when the antennae were removed, but only moderately so when they were covered. Covering or removing the tarsi had no effect [*cf. R.A.E.*, B **49** 42].

Symposium on resistance of insects to insecticides.—*Indian J. Malar.* **12** (1958) no. 4 pp. 261–636. Kanpur [? 1959].

In addition to an editorial introduction and a bibliography of selected references to the literature published in 1954–58 on the resistance of mosquitos to insecticides, by H. Sollers (pp. 627–636), this symposium consists of 40 papers. They include discussions of methods and techniques, a note on terminology and reviews of developments in this field, as well as descriptions of original work. The following are abstracts of the more important papers containing hitherto unpublished information.

Hawkins (W. B.), Moore (J. B.) & Smith (G. E.). **Tests on the resistance of *Anopheles* larvae in the region of the Tennessee Valley Authority,** pp. 317–322, 3 graphs, 7 refs. Tests having failed to reveal any significant degree of resistance to DDT in the larvae or adults of *Anopheles quadrimaculatus* Say from reservoirs of the Tennessee Valley Authority treated with DDT [*cf. R.A.E.*, B **45** 144; **46** 183], the responses of adults and larvae to selective exposure to DDT were studied. It was found that the two- to three-fold increase in tolerance shown by larvae of the F_5 generation [**45** 146] remained fairly constant, there being no further increase with selection for 18 more generations. When larvae of the 11th generation were allowed to develop without selection by DDT and further generations bred from them, tolerance returned to that of the unselected insectary strain after five generations, thus strengthening the suggestion that only a vigour tolerance had been produced [**45** 147]. The tolerance of adults of the 24th generation of the selected colony was about the same as that of the larvae. It would appear that the selective conditions necessary for the development of resistance do not exist for *A. quadrimaculatus* in the Tennessee Valley area, and it is thought that the major factor involved is the reliance placed on physical and cultural methods, rather than on insecticides, as the principal means of control.

Blázquez (J.). **Tests with larvae of *Aedes*, *Culex* and *Anopheles* in Venezuela,** pp. 323–329, 1 fig., 1 ref. In Venezuela, the susceptibility of larvae of *Culex*, *Aëdes* and *Anopheles* to chlorinated insecticides was tested in five places at which control measures had been in operation and in some of which the results had suggested that resistance might be developing. Larvae of *C. pipiens fatigans* Wied. from Caracas and Puerto Caballo showed resistance to DDT that was about 20–30 and 100–150 times that of a normal susceptible laboratory strain, and those from the first place were about 3·5–4 times as resistant to dieldrin as the normal one. The resistance to DDT and (in brackets) to dieldrin of larvae of *A. aegypti* (L.) in Caracas and Carupano was about 40–490 (5) and 7–85 (16) times the normal. In a district in Barquisimeto that had been subjected to systematic treatment with DDT against adults and larvae, resistance of larvae was 16–200 times the normal, whereas in another district, in which only sporadic residual treatment with DDT had been carried out, it was only 2·4–30 times the normal; against dieldrin, the larvae from Barquisimeto showed only about three times the normal resistance, which, like that shown at Caracas, is not a significant increase. Tests with larvae of *Anopheles* (of which 90 per cent. were *A. albimanus* Wied.) from Maracay showed normal susceptibility to DDT, dieldrin and γ BHC.

Cova García (P.). **Resistance manifestations in the behaviour of the vectors in Venezuela,** pp. 331–339, 1 fig. In view of the persistence of malaria in certain areas in Venezuela [*cf.* **47** 57] in spite of constant house-spraying with DDT since 1947, a study of the Anophelines of the area south of Lake Maracaibo was made in 1953–56 by G. Garcia Martin, who found that the percentages of adults of *Anopheles albimanus* Wied., *A. nuñez-tovari* Gabaldon and *A. darlingi* Root found dead in treated houses were 45·3, 52·9 and 56·5, respectively. Of these three vectors of malaria, *A. darlingi* is the chief. His results also showed slightly lower catches of mosquitos in sprayed than in unsprayed houses, the percentages of the three species caught in the sprayed houses being 46·1, 45·5 and 34·5, respectively. A similar situation is reported for *A. aquasalis* Curry further east, on the banks of Lake Valencia, the first resistant examples having been captured in July 1953. It is concluded that the malaria vectors in Venezuela are developing both physiological and, to a slighter degree, behaviouristic resistance to DDT.

Smith (A.). **Dieldrin resistance in** *Culex pipiens fatigans* **in north eastern Tanganyika,** pp. 341–343, 1 graph, 6 refs. It was noticed in the Pare area of north-eastern Tanganyika, where an experiment is in progress to ascertain whether malaria can be controlled by house-spraying with dieldrin [*cf.* **48** 179], that the numbers of *Culex pipiens fatigans* Wied. in huts that had been sprayed at intervals of eight months since 1955 were higher in 1957–58 than before the treatment, although they had been reduced in the two preceding years by 77 and 25 per cent., respectively; experiments were therefore undertaken to determine whether the mosquito had become resistant to the insecticide. Adults of *C. p. fatigans* from mosquito nets and of *Anopheles gambiae* Giles caught in box shelters [**42** 119] near cattle pens in November 1957 were confined on the walls of a treated hut for three hours, and all the latter and only one of the former were dead 24 hours after removal to an untreated building. When adults and larvae of *C. p. fatigans* from the treated area and from an untreated area about 70 miles away were tested for their susceptibility to deposits of dieldrin or DDT by means of World Health Organisation test-kits [**49** 199], those from the treated area were ten times as resistant to dieldrin and twice as resistant to DDT as those from the untreated one.

Chow (C. Y.). **Insecticide susceptibility and resistance in Anopheline mosquitoes in Java,** pp. 345–366, 7 refs. In tests in 1957–58 to compare the Busvine & Nash method [**41** 156] with the new World Health Organisation test outfit [**49** 199] for determining the susceptibility of mosquitos to insecticides, the LC50's of DDT for *Anopheles aconitus* Dön. and *A. annularis* Wulp from an unsprayed area in East Java obtained with the outfit were lower than those obtained with the Busvine & Nash method. In field tests in which the latter was used, the LC50's of DDT and dieldrin for nine common Anophelines from unsprayed areas in Java were found to be 0·4–2 and 0·024–0·11 per cent., respectively. Concurrent tests in which both methods were used showed that the LC50's of dieldrin for adults of *A. subpictus subpictus* Grassi, *A. s. malayensis* Hack., *A. vagus* Dön., *A. barbirostris* Wulp and *A. annularis* from places in East Java that had been sprayed with DDT, dieldrin or both were 35–300, 4–275, 3–600, 85–330 and 0–30 times those for normal strains. It was found that many local Anophelines developed resistance to dieldrin in the same place and at about the same time after spraying with the insecticide, and that the larger the number of spraying cycles, the higher was the resistance. It appeared that a lapse of at least ten months after the first round of spraying with dieldrin was required before resistant strains could be detected. All the dieldrin-resistant strains were susceptible to DDT except that of *A. s. subpictus*, which was four times as resistant as a normal strain. The two important vectors of malaria in Java are *A. sundaicus* (Rdnw.) and *A. aconitus*; the former, though resistant to DDT in many places [*cf.* **47** 86, etc.], was still susceptible to dieldrin and the possibility of development of resistance to the two compounds in the latter still requires precise determination [*cf.* **48** 46, etc.].

Patel (T. B.), Ramachandra Rao (T.), Halgeri (A. V.) & Deobhankar (R. B.). **A preliminary note on a probable case of dieldrin resistance in** *Anopheles culicifacies* **in Thana District, Bombay State,** pp. 367–370, 3 refs. After an outbreak of malaria in 1958 in Thana District, Bombay State, where good control of the disease had been obtained by spraying against mosquitos in houses in 1948–56 with DDT and subsequently with dieldrin, tests carried out in five villages showed that the LC50's of dieldrin and DDT for females of *Anopheles culicifacies* Giles, the main vector of malaria in India, were 3·1 and 0·84 per cent., respectively. The LC50 for dieldrin is 60 times as high as any recorded for this mosquito in India, but that for DDT is regarded as indicating an only slightly increased resistance.

Bhatia (S. C.), Deobhankar (R. B.) & Vittal (M.). **Susceptibilities of mosquitoes to D.D.T. and dieldrin in sprayed and unsprayed areas of Bombay State, India,** pp. 371–376, 1 graph, 1 ref. In tests on female mosquitos caught in 1957 in several places in Bombay State that had previously been sprayed with DDT or dieldrin, or with both compounds or with neither, the percentage LC50's of DDT and (in brackets) of dieldrin were 0·2–0·6 (0·02–0·05) for *Anopheles culicifacies* Giles in sprayed and unsprayed areas [*cf.* **48** 45], 0·9–2·1 (0·1–0·35) for *A. stephensi* List. from unsprayed areas, 2·7 (0·07) for *A. annularis* Wulp. from sprayed areas, 0·6–3 (7–>20) for *A. subpictus* Grassi from sprayed, and 0·5–2·8 (5·6) from unsprayed, areas and >20 (6–>20) for *Culex pipiens fatigans* Wied. from sprayed, and >20 (0·3–0·7) from unsprayed, areas.

Ganguli (N.) & Sinha (G. C.). **Susceptibility to D.D.T. of principal malaria vectors of West Bengal,** pp. 377–382, 7 refs. Field observations in West Bengal indicated that *Anopheles philippinensis* Ludl., *A. sundaicus* (Rdnw.) and *A. minimus* Theo. continue to be susceptible to DDT, even after the application of deposit sprays of the insecticide for over five years.

Rajindar Pal. **Present status of susceptibility of some species of mosquitoes to D.D.T., B.H.C. and dieldrin,** pp. 383–399, 2 figs., 20 refs. The following is substantially the author's summary of an account of tests of the susceptibility of mosquitos to DDT, BHC and dieldrin in various parts of India taken from both unpublished and published sources. The susceptibility of malaria vectors to DDT and BHC has remained practically unchanged [*cf.* **46** 202; **48** 45, 47; and above] except for the development of resistance to DDT in *Anopheles stephensi* List. [*cf.* above] in Erode, Madras, *A. subpictus* Grassi [*cf.* **48** 45; **49** 201; and above] in West Bengal and *A. annularis* Wulp in Papatpura, Bombay State. Resistance to DDT is also reported in *Culex pipiens fatigans* Wied. [*cf.* **49** 110] in Bombay [*cf.* above], Uttar Pradesh, Delhi State and Orissa. *A. culicifacies* Giles is highly susceptible to DDT and BHC and *A. minimus* Theo. is susceptible to all three insecticides. Sporadic cases of high tolerance to dieldrin were observed in *A. splendidus* Koidz. in Bihar, and in *A. subpictus* in Bombay [*cf.* above] and West Bengal. Specific cases of resistance to dieldrin were also observed in *A. culicifacies* in Bombay [*cf.* above] and *C. p. fatigans* in Bombay [*cf.* above] and Uttar Pradesh, in which areas deposit sprays of dieldrin had been applied.

Mathis (W.) & Schoof (H. F.). **Field effectiveness of malathion deposits against dieldrin-resistant** *Anopheles quadrimaculatus*, pp. 433–437, 2 refs. In 1958, further evaluations of the effectiveness of the sprayed removable plywood panels used in Georgia in tests under simulated field conditions in 1957 [**49** 61] showed that those treated with malathion at 100 mg. per sq. ft. gave essentially complete control of dieldrin-resistant females of *Anopheles quadrimaculatus* Say for 12 months, at which time the test was terminated, and of susceptible females (which were available for a longer period) for 15 months, with evidence of failure after 16 months, when only 57 per cent. control was obtained. Tests were also carried out in Mississippi in vacant and occupied houses, in which field-collected dieldrin-resistant females of *A. quadrimaculatus* were exposed either free or in plastic cones attached to the walls in rooms of which the walls and ceiling had been sprayed with malathion at 50 or 100 mg. per sq. ft., alone or with 100 mg. DDT, or with either of the insecticides alone at 200 mg. per sq. ft.; in the occupied houses, malathion was not applied at the last rate and the only mosquitos exposed were females in cones. The results showed complete kills of the free mosquitos and of those exposed in cones for the 25 weeks of the test in the unoccupied houses, except in one room treated with malathion at 50 mg.

per sq. ft., and of the females in the cones for the 12–16 weeks of the test in the occupied houses.

Rajindar Pal & Kalra (R. L.). **Comparative susceptibility of D.D.T.-resistant and normal *Culex fatigans* larvae to diphenyl methane derivatives, chlorinated hydrocarbons and organophosphorus insecticides,** pp. 439–445, 2 figs., 10 refs. Various derivatives of diphenyl methane were found to be toxic to larvae of *Culex pipiens fatigans* Wied. of a susceptible strain and of a DDT-resistant strain from a village in Delhi that had been sprayed with DDT since 1947; the most toxic was 4-hydroxy-3′-chlorodiphenyl methane, with LC50's of 1·7 and 3·4 parts per million for susceptible and resistant larvae, respectively. When larvae of both strains were exposed to DDT, DDD, dieldrin, BHC, malathion and mevinphos (Phosdrin), malathion was the most toxic, being 300 and 10 times as toxic as DDT to resistant and susceptible larvae, respectively, and it seemed that spraying with DDT for about ten years had resulted in the selection of a strain of *C. p. fatigans* that showed a very high degree of resistance to DDT and was also resistant to DDD, but showed only vigour tolerance to BHC, organophosphates and cyclodienes.

Keiding (J.). **The relation between resistance to insecticides and the effect of cetyl bromoacetate in Danish strains of *Musca domestica* L.,** pp. 453–468, 2 graphs, 11 refs. The following is substantially the author's summary. Determinations were made of the rate of knockdown by cetyl bromoacetate [*cf.* **49** 96, etc.] of adults of two susceptible strains of *Musca domestica* L. and of eight strains derived from collections on three farms in Denmark on which flies had developed resistance to chlorinated hydrocarbons or to chlorinated hydrocarbons and organophosphates. Exposure was by continuous tarsal contact with aluminium foil bearing acetone solutions of the compound. Sub-strains with different combinations of resistance to DDT, γ BHC (lindane) and diazinon were obtained by breeding with or without selection with insecticides. Comparison of such sub-strains of common origin showed that both sexes of an insecticide-resistant strain were more resistant to knockdown by cetyl bromoacetate than susceptible strains, although in some cases, especially when young flies were used, the difference in susceptibility to cetyl bromoacetate of the two strains was insignificant. When selection with cetyl bromoacetate was carried on through ten generations in two sub-strains, their resistance to DDT increased in the first generation, but did not do so further in later ones. A certain increase in the time required for knockdown by cetyl bromoacetate was also noticed. The results of these tests indicated a positive relation between resistance to insecticides and tolerance of cetyl bromoacetate [*cf. loc. cit.*].

Rajindar Pal & Singh (N. N.). **Inheritance of D.D.T.-resistance in *Culex fatigans*,** pp. 499–516, 4 figs., 20 refs. The following is substantially the authors' summary. The inheritance of resistance to DDT in *Culex pipiens fatigans* Wied. was studied by crossing susceptible and resistant strains. It is concluded that DDT-resistance is due to a single recessive gene or group of genes, associated not with the sex chromosome but with one of the autosomes; in addition, the results are regarded as indicating cytoplasmic influence.

Bradbury (F. R.), Campbell (A.) & O'Carroll (F. M.). **The waxes and lipoids of resistant houseflies and mosquitoes,** pp. 547–564, 23 refs. Examination of the epicuticular waxes and the lipoids of adults of five strains of *Musca domestica* L. and five strains of *Anopheles gambiae* Giles showed no difference between the amounts of the waxes in γ BHC-resistant and susceptible strains and a considerable degree of similarity between the chemical and physical properties of their lipoids. The amounts of lipoids in resistant strains were equal to or less than those in susceptible ones. There was little or no difference between the solubility of γ BHC in the waxes and lipoids of resistant and susceptible strains, or in its rate of penetration in a susceptible and in a highly resistant strain of house-flies. These results do not support the theory that the fatty tissues retain this insecticide and so contribute to the defence mechanism of strains resistant to γ BHC [*cf.* **43** 114; **47** 8].

Meltzer (J.). **Unspecific resistance mechanisms in the house-fly,** *Musca domestica* **L.,** pp. 579–588, 2 graphs, 14 refs. The following is substantially the author's summary. Four insecticide-resistant strains of *Musca domestica* L. were developed by selection with DDT (RD), diazinon (RP), γ BHC (lindane) (RL) and phenyl dimethylcarbamate (RS), respectively. Resistance to the compound used for selection developed in all the strains except RS, though that induced in RP was of a much lower order than that induced by the two chlorinated hydrocarbons. All four strains showed resistance to chlorinated hydrocarbons (including toxaphene, dieldrin, aldrin and chlordane, as well as the two used in selecting strains), except that the RS strain did not become resistant to DDT. The level of resistance in a strain was independent of the selecting agent, though it ranged in the same order in all strains, being highest to DDT and toxaphene, decreasing through dieldrin, aldrin, chlordane and γ BHC, and being low to the organophosphate and negligible to the carbamate. It is considered more likely that multi-resistance is based on non-specific than specific detoxifying mechanisms and it is supposed that a decrease in permeability of the cell membrane is of importance as an unspecific factor [*cf.* **47** 72]. Though the carbamate induced multi-resistance, the mechanism of this was not sufficiently effective to protect the insect against the carbamate itself, which was shown to have strong penetrating powers.

Koshi (T.) & Ranganathan (S. K.). **Influence of relative humidity on the normal tolerance of the mosquito,** *Culex fatigans* **Wied., to D.D.T.,** pp. 589–600, 2 graphs, 20 refs. The normal tolerance of an insect for an insecticide is distinguished from vigour tolerance [*cf.* **47** 72] (which has been described as the increased ability of a strain to withstand many kinds of stresses, including exposure to chemicals, resulting from the selection of those individuals that survive such diverse stresses as extremes of temperature, lack of moisture and abnormal food), and the factors reported in the literature as governing it are described. The variations in the normal tolerance of laboratory-reared females of *Culex pipiens fatigans* Wied. exposed at fortnightly intervals to filter papers bearing deposits of DDT were studied over a period of eight years, and it was found that increases in relative humidity increased the normal tolerance of the insect to the insecticide.

Ungureanu (E.), Duport (M.) & Sandulescu (M.). **Susceptibility and seasonal tolerance of local adult** *Anopheles* **to long-time use of D.D.T. and B.H.C.,** pp. 601–609, 16 refs. The following is based on the authors' conclusions from observations carried out in 1956–57 on Anophelines collected in various localities in Rumania. The vectors of malaria, *A. maculipennis maculipennis* Mg., *A. m. messeae* Flni., *A. labranchiae atroparvus* van Thiel and *A. sacharovi* Favr, have acquired no physiological resistance to insecticides in places in which buildings have been treated with DDT or BHC for 8–11 years, though the tolerance of these mosquitos for DDT was doubled and that for γ BHC and dieldrin was still more greatly increased during the pre-hibernation period. The susceptibility of these mosquitos to insecticide deposits has remained such that their use against the adults can be continued in the Rumanian eradication programme.

Ascher (K. R. S.). **A common information source for all resistance problems in biology is urgently needed in view of the paucity of effective countermeasures to insecticide-resistance!,** pp. 615–625, 87 refs. Although it has been shown that resistance to DDT in certain strains of house-flies (*Musca domestica* L.) is accompanied by resistance-induced enhanced susceptibility to certain other chemicals [*cf.* **49** 61, etc.], none of the latter [*cf.* **48** 58; **49** 112] is powerful enough to afford much control in practice, such an approach is unlikely to be applicable to all resistant strains, even of a single species, and resistance may develop to these compounds themselves. Kearns was reported in 1957 to have resensitised a strain of *M. domestica* resistant to DDT (but containing 5 per cent. of susceptible individuals) in three generations with an impure preparation of 1,2,2,2-tetrachloroethyl phosphoric acid, but an attempt made by the author in 1955 to resensitise a highly DDT- and polyvalent-resistant strain by incorporating various chelating agents, agents precipitating heavy metals, heavy-metal salts, strong enzyme-inhibitors, alkali and alkaline-earth chlorides, alkali bromides and thiourea into the breeding medium at a rate permitting 20 per cent. adult emergence showed that only sodium chloride at the high rate of 5 per cent. caused any reduction in DDT-resistance. Some reduction was also afforded by feeding adults for a few days on sodium-chloride solutions. The reductions observed were, however, of no practical value. The failure of synergists to provide a practical answer to the problems of resistance and the use of tarsal contact agents that prevent oviposition [*cf.* **47** 139], of exsiccating and sticking agents and of abrasive dusts are discussed, and it is suggested that information on resistance in every field of biology should be collated in abstract form.

Peffly (R. L.). **Insecticide resistance in Anophelines in eastern Saudi Arabia.**—*Bull. World Hlth Org.* **20** no. 5 pp. 757–776, 2 maps, 16 refs. Geneva, 1959. (With a summary in French.)

Resistance to DDT in *Anopheles stephensi* List. in eastern Saudi Arabia was first noticed in 1953, and the replacement of DDT by dieldrin for Anopheline control in 1955 was followed by a fall in malaria rates [*R.A.E.*, B **49** 159]. Local strains of *A. stephensi* did not become resistant to dieldrin, the LC50 of this insecticide varying from 0·06 to 0·17 per cent., irrespective of resistance to DDT, as compared with 0·13 per cent. for a London susceptible colony. No adults of *A. stephensi* have been collected from treated villages since the use of dieldrin became widespread. Those used in the tests were collected outside the villages, in garden shelters that may have been overlooked. *A. pulcherrimus* Theo., *A. coustani tenebrosus* Dön., *A. fluviatilis* James and *A. sergentii* (Theo.) all remained susceptible to DDT, but the first two developed resistance to dieldrin, LC50's of which varied from 0·4 to more than 8 per cent. for *A. pulcherrimus* and more than 5 per cent. for *A. c. tenebrosus*. *A. pulcherrimus* was rarely collected before and during the use of DDT but has become increasingly frequent since the introduction of dieldrin, and although there is not complete agreement on its rôle in the transmission of malaria, enough evidence is cited to show that those responsible for the control of the disease should be watchful.

The measurements and ratios of several series of eggs obtained from locally collected females of *A. stephensi* fell well within the limits of the range set for *A. stephensi mysorensis* Sweet & Rao [**26** 50], which has not previously been recorded outside the Indian subcontinent.

Elliott (R.). **Insecticide resistance in populations of** *Anopheles gambiae* **in West Africa.**—*Bull. World Hlth Org.* **20** no. 5 pp. 777–796, 6 figs., 8 refs. Geneva, 1959. (With a summary in French.)

The following is mainly based on the author's summary. Early fourth-instar larvae of strains of *Anopheles gambiae* Giles from various parts of West Africa were tested for resistance to γ BHC and dieldrin by the short-exposure method described by the author [*R.A.E.*, B **49** 16], and the results were analysed to provide information as to the proportions of the three possible genotypes in the different populations. At Kano, Northern Nigeria, where the use of insecticides has been limited to protection of the airport with DDT and BHC and of piles of groundnuts, awaiting transport, with BHC, the gene conferring resistance to dieldrin and γ BHC [**49** 68, 93, etc.] appears to be increasing in the wild population, being present in about 50 and 42 per cent. of the population in the homozygous-resistant (RR) and heterozygous (RS) states, respectively, as compared with 30 and 20 per cent. in 1956. Theoretical considerations suggest that in a situation in which the male heterozygote is sterile [*cf.* **49** 93], the gene in the minority will tend to become extinct in the absence of any specific selection. In a colony, derived from females collected in Kano near the airport and the area where the groundnuts had been held, and maintained in Lagos for six generations without intentional selection, the reverse was seen to happen, the S gene increasing at the expense of the R gene, so that it seems that some fortuitous selection favouring the S gene must have occurred, either through a bias in the selection of material or because of conditions of life in small colonies. In Sokoto Province, where DDT, γ BHC and dieldrin have been applied as house-sprays [**48** 233], some figures of the same type gave results compatible with those from Kano, especially as regards the LC50 level calculated for the effect of γ BHC on the RS fraction of the population. At Freetown, Sierra Leone, where DDT has been used extensively as a larvicide since 1945 and γ BHC has been used against adults since 1952, there was similar evidence of the appearance of the factor conferring resistance to γ BHC, and about 66 per cent. of the sample examined appeared to carry the R gene. At Ibadan, Western Nigeria, where limited use has been made of DDT, almost entirely as a larvicide, samples of the population showed some tolerance to dieldrin, but this appeared to be non-specific, as some relative tolerance to DDT was present also.

de Zulueta (J.). **Insecticide resistance in** *Anopheles sacharovi.*—*Bull. World Hlth Org.* **20** no. 5 pp. 797–822, 1 graph, 26 refs. Geneva, 1959. (With a summary in French.)

The following is based on the author's synopsis. The results are given of observations on the susceptibility or resistance to insecticides of *Anopheles sacharovi* Favr made in 1956 in Persia, in 1957 and 1958 in Italy and in 1958 in Greece, Rumania and Turkey. Susceptibility in adults was measured by exposure of the mosquitos on impregnated filter papers by the method of Busvine & Nash [*R.A.E.*, B **41** 156] or a similar method [**49** 199]. High physiological resistance to DDT was observed in the Tarsus area of southern Turkey. In Greece, very marked physiological resistance to dieldrin [**45** 109; **46** 203] was found in all the areas examined and was associated, at least in the Peloponnese, with a resistance to DDT that affected only a part of the population. In Italy and Rumania, after ten years' use of DDT, *A. sacharovi* was still susceptible; long use of BHC in Rumania had not resulted in the development of resistance to BHC itself or to dieldrin [*cf.* **49** 231].

There were indications of resistance to DDT in Persia, but further investigation of the situation is considered necessary as the number of mosquitos studied was very small. The fact that the use of DDT in Greece, after the development of resistance to this insecticide in 1951 [*cf.* **42** 32], has not resulted in the formation of a highly resistant mosquito population is considered to be due to the irritant effect of the DDT on susceptible mosquitos, causing them to leave sprayed surfaces before they have picked up a lethal dose. This irritant effect was shown to be less in *A. sacharovi* from an area in which its resistance was highest than in *A. sacharovi* from another area in which only a few individuals were resistant. The information so far available points to the existence in *A. sacharovi* of two independent mechanisms of physiological resistance, one to DDT and another to dieldrin and BHC, which may or may not be present together.

Clarke (T. H.) & Cochran (D. G.). **Cross-resistance in insecticide-resistant strains of the German cockroach,** *Blattella germanica* **(L.).**—*Bull. World Hlth Org.* **20** no. 5 pp. 823–833, 8 graphs, 19 refs. Geneva, 1959. (With a summary in French.)

An account is given of experiments designed to assess the extent of cross-resistance in insecticide-resistant strains of *Blattella germanica* (L.). Females of a DDT-resistant, a chlordane-resistant and a non-resistant strain were placed in small screen cages and dipped for 20 seconds in water suspensions of DDT, methoxy-DDT (methoxychlor), chlordane, dieldrin, Prolan, malathion, allethrin or a thiocyanate (Lethane) at five different concentrations, and left in the treated cages for 60 minutes before removal to recovery cages. The mortality data obtained are shown in the form of regression lines. The results indicated that the DDT-resistant strain is highly resistant to DDT and to its analogue, methoxy-DDT, but did not show more than fourfold resistance to any of the other insecticides tested. Similarly, the chlordane-resistant strain was highly resistant to chlordane and to its analogue, dieldrin, but was susceptible to the other toxicants. From these results, as well as those of other workers [*cf. R.A.E.*, B **42** 136; **43** 24; **46** 168; **48** 207], it appears that the picture of cross-resistance in *B. germanica* is in essential agreement with that which is emerging for other insects throughout the world [*cf.* **41** 158–160; **45** 145; **47** 71–73].

Gratz (N. G.). **A survey of bed-bug resistance to insecticides in Israel.**—*Bull. World Hlth Org.* **20** no. 5 pp. 835–840, 5 refs. Geneva, 1959. (With a summary in French.)

Tests for resistance to DDT and γ BHC were made on 14 strains of bed-bugs (*Cimex lectularius* L.) collected from various places in Israel, in comparison with a normally susceptible laboratory strain. The bugs were exposed for 24 hours in petri dishes to deposits from acetone solutions of various strengths. One strain from an area in which insecticides had not been used was more susceptible to DDT than the laboratory one, but most strains, including some from widely separated areas, showed a very high degree of resistance. Six strains were more than 200 times as resistant as the most susceptible. A moderate to low degree of resistance to γ BHC was observed in several strains [*cf. R.A.E.*, B **45** 152], but there was no marked resistance to high concentrations, and most strains were more susceptible than the laboratory one.

ROSEN (P.) & GRATZ (N. G.). **Tests with organo-phosphorus dry sugar baits against houseflies in Israel.**—*Bull. World Hlth Org.* **20** no. 5 pp. 841–847, 3 refs. Geneva, 1959. (With a summary in French.)

As dry sugar baits containing organophosphorus insecticides are cheap and easy to apply, involve comparatively small toxic hazards to animals and have given good control of *Musca domestica* L. elsewhere [*cf. R.A.E.*, B **44** 73–74], their effectiveness against house-flies (mainly *M. domestica vicina* Macq. [**47** 84]) in Israel was examined. The tests were made in cow sheds, a calf shed and fowl houses of the battery type. The baits were spread, generally along the concrete central passages, from a shaker can, and, with one exception, were applied daily throughout the period of the test. Grill counts [**38** 158] were reduced by 50 per cent. in 2½ hours or less in seven of the ten tests, and a reduction of more than 70 per cent. on the fourth day was indicated in six. Malathion at 2·5 per cent. with 10 per cent. sugar and 87·5 per cent. sand applied daily for one week, on alternate days in the second week and at intervals of three days in the third week reduced counts in a fowl house where sanitation was good by 94·6 per cent. in five days and by 80·5 per cent. as long as 12 days after applications ceased. The same bait in the calf shed, where sanitation was very bad, gave a reduction of 63·9 per cent. by the 15th day and had practically no lasting effect on population. Malathion at 1 per cent. was much less effective. Diazinon at 1 per cent. with 87·5 per cent. sugar and 11·5 per cent. sand reduced counts in a cow shed by 94·8 per cent. in six days, and the reduction reached 97·4 per cent. by the 19th day and was 93·5 per cent. ten days after application ceased. A lighter application of 1 per cent. diazinon, 10 per cent. sugar and 89 per cent. sand in a fowl house with good sanitation gave a reduction of 95·2 per cent. after five days, and 70·2 per cent. ten days after application ceased. Trichlorphon (Dipterex) at 1 per cent. with 2·5 per cent. sugar and 96·5 per cent. sand gave a reduction of 50 per cent. after one hour in a fowl house and 92·9 per cent. after eight days, but the reduction had fallen to 57·2 per cent. 14 days after applications ceased. Used at 1 per cent. in an inert carrier in a cow shed, it gave a reduction of 91·7 per cent. after five days and 95·3 per cent. four days after applications ceased. Chlorthion at 1 per cent. in an inert carrier gave a maximum reduction during treatment of 77·5 per cent., reached after the third application. Thereafter, counts fluctuated, and there was little evidence of effect four or more days after treatment ceased. It is concluded that dry poisoned baits can be an important supplementary measure to a rural fly control programme, especially when used as an adjunct to good sanitation, and dilution of sugar with sand reduces cost and facilitates pouring. The observation that sugar baits do not become attractive until contaminated by flies [**44** 68] was confirmed.

COVA GARCÍA (P.) & SUTIL O. (E.). **La propreté domestique et l'emploi des insecticides phosphorés dans la lutte contre les mouches.**—*Bull. World Hlth Org.* **20** no. 5 pp. 849–859, 6 graphs, 1 ref. Geneva, 1959. (With a summary in English.)

An account is given of a detailed study made from 1952 to 1957 of the fly populations of Maracay and other Venezuelan towns. The species involved were *Musca domestica* L., which was mainly found indoors, and two species of *Sarcophagula* (*occidua* (F.) and *canuta* Wulp), which occurred almost exclusively in the open. *M. domestica* bred chiefly in domestic refuse, and the amount of refuse available greatly influenced populations of this species. An increase in the frequency of refuse collections was followed by a sharp fall in the population of *Musca*, but no corresponding fall in the population of the species of *Sarcophagula*, which bred to a considerable extent in excreta as well as in domestic refuse. *S. occidua* appeared to be associated mainly with human, and *S. canuta* with animal excreta, but this may have resulted from differences in availability. It is concluded that for satisfactory fly control, there must be action against domestic animals and improved disposal of human excreta as well as adequate disposal of domestic refuse. The use of cords impregnated with organophosphorus insecticides such as diazinon, Chlorthion or coumaphos (Muscatox) in stables, cow sheds, etc. increased control of *M. domestica*, as did malathion flakes or trichlorphon (Bayer L 13/59) in granules as an emergency measure, but it had no effect on *Sarcophagula* populations as these flies did not come indoors.

Hayes jr. (W. J.). **The toxicity of dieldrin to man. Report on a survey.**—*Bull. World Hlth Org.* **20** no. 5 pp. 891–912, 11 refs. Geneva, 1959. (With a summary in French.)

The following is based on the author's synopsis. The use of dieldrin for the control of Anopheline vectors of malaria has increased for several reasons, including sporadic resistance of some species to DDT. Poisoning by dieldrin of men employed in spraying has been recognised in five widely separated countries (Venezuela, Ecuador, Nigeria, Java and India) and reported informally from several others. In some cases, illness has recurred months after the last exposure. Observations during Anopheline control programmes in Kenya, Tanganyika [*cf. R.A.E.*, B **49** 167], Indonesia, India (Bombay State) and Persia, which are briefly described, and a review of the relevant literature, showed that the hazard associated with dieldrin is proportional to the degree of workers' exposure as determined by concentration of spray, area of bare skin, duration of contact, and lack of hygiene. Measurements of workers' exposure and investigation of the different routes by which poisoning occurs showed skin contamination to be the greatest hazard under practical conditions [*cf.* **49** 167]. Inhalation is comparatively unimportant because most wettable powders are largely composed of dieldrin-impregnated particles that are too large to be inhaled. It is considered that the use of dieldrin should be avoided if possible. If it is necessary, the adoption of certain individual and group protective measures, a list of which is given, may reduce but not necessarily eliminate the risk.

Pearce (G. W.), Gooden (E. L.) & Johnson (D. R.). **Specifications of the International Cooperation Administration for DDT water-dispersible powder for use in malaria control programmes.**—*Bull. World Hlth Org.* **20** no. 5 pp. 913–920, 4 refs. Geneva, 1959. (With a summary in French.)

An account is given of the development of the specifications drawn up by the International Co-operation Administration of the United States Government for 75 per cent. DDT water-dispersible powders to be used in sprays against Anophelines in malaria control or eradication programmes. These water-dispersible powders are the most practical formulations for this purpose, but a serious problem is created by the difficulty of keeping them in suspension when, as is usual, the spraying equipment used is without agitators, and particularly when the powders have to be stored for a long time under tropical conditions. The success of a control programme depends on the establishment of stringent specifications concerning formulation and packing to guarantee adequate suspensibility. The test of suspensibility that has been devised is described in this paper, and the importance of the inspection of the material received is discussed.

Pearce (G. W.), Goette (M. B.) & Sedlak (V. A.). **Storage stability of DDT water-dispersible powders.**—*Bull. World Hlth Org.* **20** no. 5 pp. 921–936, 4 graphs, 6 refs. Geneva, 1959. (With a summary in French.)

The following is based on the authors' synopsis. A study of the change in suspensibility [*cf.* preceding abstract] of various commercially prepared 75 per cent. DDT water-dispersible powders during storage in simulated commercial packages at 27, 50 and 65°C. [80·6, 122 and 149°F.] and at ambient temperatures is described. The results showed that good initial suspensibility is no criterion of ability to withstand prolonged storage, and suspensibility after tropical storage pre-treatment (heating under a specified weight for 20 hours at 55°C. [131°F.]) is no criterion of stability, but periodic observations, made over a month or more, of the suspensibility of powders stored at 50 and 65°C. will provide an indication of the probable long-term stability of a product, and it seems likely that a reasonable estimate of long-term storage stability at ambient temperatures could be obtained by subjecting the samples to high temperatures for a very short period.

Miles (J. W.), Goette (M. B.), Grimm (L.) & Pearce (G. W.). **Factors affecting the suspensibility of DDT water-dispersible powders.**—*Bull. World Hlth Org.* **20** no. 5 pp. 937–945, 2 graphs, 4 refs. Geneva, 1959. (With a summary in French.)

Pearce (G. W.), Miles (J. W.) & Goette (M. B.). **Factors affecting the suspensibility of dieldrin water-dispersible powders.**—*T. c.* pp. 947–953, 2 graphs, 2 refs. (With a summary in French.)

The following paragraph is substantially the authors' synopsis of the first paper. Experiments carried out to determine the effect of moisture, temperature and pressure on the suspensibility of DDT water-dispersible powders are described. They showed that the removal of moisture brought about a slight increase in suspensibility; that heating for one hour at temperatures below 70°C. [158°F.] resulted in an increase in suspensibility, due probably to the drying effect of the heat, whereas heating for the same period at temperatures above 70°C. resulted in a decrease; that on prolonged heating at 70°C. and 75°C. [167°F.], the suspensibility decreased sharply in the first four hours but thereafter showed little change up to 20 hours; and, finally, that low pressures (for example, 25 g. per sq. cm.) had little effect on suspensibility, but that at pressures of 100 lb. per sq. in. and over, suspensibility varied inversely as the logarithm of the pressure.

The second paper contains an account of tests of the suspensibility of various water-dispersible powders containing dieldrin stored for periods of one week to four months at 50 and 65°C. [122 and 149°F.]. It was found that there was wide variation in the suspensibility of the powders, believed to be attributable to properties of diluents of unstated composition. When a series of samples of the most satisfactory preparation was subjected to temperatures of 90–120°C. [194–248°F.] for periods of 1–20 hours, most of the samples withstood the treatment reasonably well at temperatures up to 110°C. [230°F.] for 20 hours.

Jones (J. C.). **Some effects of dieldrin on** *Anopheles* **mosquitos.**—*Bull. World Hlth Org.* **20** no. 5 pp. 987–990. 1 ref. Geneva, 1959.

All third-instar larvae of *Anopheles quadrimaculatus* Say continuously exposed to 0·004 part per million dieldrin and 80–100 per cent. of those exposed to 0·002 p.p.m. died within 24 and 48 hours, respectively. When third-instar larvae or larvae that had been one day in the fourth instar were immersed in 0·5 p.p.m. dieldrin for 15 or 20 mins. and rinsed twice in distilled water [*cf.* *R.A.E.*, B **47** 53], less than 20 per cent. survived to produce adults. For a similar survival rate, larvae that had been two days in the fourth instar had to be exposed for 30 mins. in the same concentration or for 20 mins. in 1 p.p.m. When individuals that had pupated 1–18 hours earlier were exposed to 0·5 p.p.m. dieldrin for five mins. and then rinsed four times in distilled water, less than half were killed in the pupal stage, but 69 per cent. of the females and 88 per cent. of the males died by the end of the third day in the adult stage. Exposure for 30 or 50 mins. resulted in complete mortality by the end of the first day of adult life in males or the second in females. Individuals that had been 24 hours in the pupal stage were more tolerant, but nevertheless exposure for 15 mins. resulted in 90 per cent. mortality in females and 100 per cent. in males by the end of the third day of adult life.

Ungureanu (E.). **Observations on the susceptibility of** *Anopheles gambiae* **to dieldrin assessed by topical application.**—*Bull. World Hlth Org.* **20** no. 5 pp. 990–994, 2 refs. Geneva, 1959.

In experiments on the relative susceptibility to dieldrin of a susceptible strain of *Anopheles gambiae* Giles from Diggi (Northern Nigeria), two strains of resistant homozygotes from Bobo-Dioulasso (Haute Volta) and Kano (Northern Nigeria) and a hybrid (susceptible × Kano) strain, the LD50's by topical application for these strains were 0·002–0·0025, 0·3, >2·5 and 0·05–0·07 μg. per mosquito, respectively [*cf.* *R.A.E.*, B **45** 68]. The Kano strain had a darker and seemingly tougher integument than the susceptible strain, and the hybrids were intermediate in appearance. It was possible to distinguish females of these three strains with the naked eye. It is suggested that the morphological differences may extend beyond the integument to internal structures that have an important bearing on tolerance.

Cerf (J.) & Lebrun (A.). **Résistance de** *Culex pipiens fatigans* **aux hydrocarbures chlorés à Léopoldville** (**Congo belge**).—*Bull. World Hlth Org.* **20** no. 5 pp. 994–1001, 1 ref. Geneva, 1959. **Note préliminaire sur l'utilisation en pulvérisation domiciliaire d'un insecticide organophosphoré rémanent** (**Baytex**).—*T. c.* pp. 1001–1005.

The development of resistance in *Culex pipiens fatigans* Wied. in Leopoldville to DDT and BHC, which had been in use as house sprays for Anopheline control (the former for eight years), is recorded in the first paper. A series of tests on larvae indicated considerable resistance to DDT, recently developed resistance to BHC and cross-resistance to dieldrin but full susceptibility to various organophosphorus compounds. The results for DDT and dieldrin were confirmed by tests on adults by the method of Busvine & Nash [*R.A.E.*, B **41** 156], 4 per cent. of the former giving no mortality and 1·6 per cent. of the latter only 20 per cent. As no organophosphorus compound was known that was sufficiently effective, lasting, cheap and safe to be recommended for practical use as deposit sprays in place of DDT or

BHC, tests were made with aerosols and larvicidal oils. The latter gave good results alone provided that the film remained intact long enough, and the addition of 0·3 per cent. malathion or Chlorthion made the action more rapid. In aerosols, DDT, BHC and dieldrin again gave very poor control and so did Pyrolan, but Chlorthion, fenchlorphos (Korlan), diazinon, malathion, Thanite and 1 per cent. pyrethrins with 2·5 per cent. piperonyl butoxide all gave complete control of both adults and larvae. Chlorthion and fenchlorphos were rapid in action, as was Thanite against the adults. The mixture of pyrethrins and piperonyl butoxide was very rapid but expensive.

Tests in 1958 of the effectiveness of house-spraying with O,O-dimethyl O-3-methyl-4-methylthiophenyl phosphorothioate [*cf.* **49** 30] are described in the second paper. This compound is of low toxicity to mammals with an oral LD50 of 0·2–0·225 g. per kg. for rats and low cutaneous absorption and vapour pressure; it is resistant to alkalis and thermostable. The mean temperature at Leopoldville is 25°C. [77°F.] and the relative humidity of the air is 85 per cent. The surfaces treated were bare mud or limewashed concrete. On 5th June, 400 houses in one sector were treated with 20 per cent. wettable powder at 1 g. per sq. metre, but this stained painted or limewashed walls. On 30th October, 80 dwellings in another sector were treated with 0·5 g. 40 per cent. wettable powder, and this was much more acceptable. Average numbers of adults of *C. p. fatigans* caught per house in 15 minutes in the morning were reduced from about 4 to 0·1 for 32 weeks by the 20 per cent. powder and for 12 weeks by the 40 per cent. powder. These periods were the durations of the experiments. The 20 per cent. powder gave complete protection for 25 weeks. In tests on freshly fed females of *C. p. fatigans* caged against a treated wall, 100, 95, 86 and 70 per cent. control was noted after 12, 13, 17 and 26 weeks on bare mud and 100, 100 and 85 per cent. after 14, 26 and 33 weeks on limewashed concrete. A control rate of 70 per cent. is considered satisfactory to keep *C. p. fatigans* in check in Leopoldville.

BRELAND (O. P.). **Restoration of the name,** *Aedes hendersoni* **Cockerell, and its elevation to full specific rank (Diptera: Culicidae).**—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 600–606, 5 figs., 17 refs. College Park, Md., 1960.

A study of material from central Texas and Boulder, Colorado, and of the type showed that *Aëdes hendersoni* Ckll., which has been considered a variety or synonym of *A. triseriatus* (Say) [*cf. R.A.E.*, B **6** 146], is specifically distinct. The adults and larva are described from Colorado material, and observations on the ecology and distribution of *A. hendersoni* are recorded; like *A. triseriatus*, it breeds in tree holes. There were some differences between examples from the two States.

JUDSON (C. L.). **The physiology of hatching of Aedine mosquito eggs: hatching stimulus.**—*Ann. ent. Soc. Amer.* **53** no. 5 pp. 688–691, 1 graph, 9 refs. College Park, Md., 1960.

The following is virtually the author's abstract. By polarographic determination of the dissolved-oxygen concentration of media used to flood eggs of *Aëdes aegypti* (L.) and *A. nigromaculis* (Ludl.), the effect of dissolved oxygen in stimulating hatching was found to be twofold. An inverse relation occurred between dissolved oxygen and hatching of eggs flooded under conditions of static oxygen level, very low levels being required to induce a high degree of hatching. In contrast, even a slight lowering of the oxygen level while eggs were flooded proved a powerful hatching stimulus. A decline lasting several hours was found in the dissolved oxygen level at the soil-water interface of flooded soil, so that a decreasing level, rather than merely a very low level, of dissolved oxygen seems to represent the natural mode of stimulation. Exposure of eggs to 50 per cent. relative humidity significantly reduced the hatching response as compared with that of eggs kept under high-humidity conditions.

TESKEY (H. J.). **Survey of insects affecting livestock in southwestern Ontario.**—*Canad. Ent.* **92** no. 7 pp. 531–544, 6 figs., 15 refs. Ottawa, 1960.

The species studied during this survey of pests of livestock in south-western Ontario in 1957–58 included *Hypoderma bovis* (Deg.), *Siphona irritans* (L.), Tabanids, Simuliids and other Diptera, notably *Musca autumnalis* Deg. on cattle, *Gasterophilus intestinalis* (Deg.) and *G. nasalis* (L.) in horses, *Melophagus ovinus* (L.) and *Oestrus ovis* L. affecting sheep, lice on cattle, sheep, goats, pigs and fowls and mites on fowls. The importance of *O. ovis*, which was found in the heads of 70 per cent. of the sheep examined, Tabanids and *Musca autumnalis* was hitherto unsuspected; the last fed on serous discharge of the eyes and nose of cattle and caused great annoyance [*cf. R.A.E.*, B **49** 193]. *M. domestica* L. and *Stomoxys calcitrans* (L.) were common in farm buildings.

CHANDLER (A. C.) & READ (C. P.). **Introduction to parasitology with special reference to the parasites of man.**—10th edn., 9¼ × 6 in., xii + 822 pp., 258 figs., many refs. New York, N. Y., & London, J. Wiley & Sons, Inc., 1961. Price £3 18*s*.

This tenth edition of a well-known textbook on the parasitology of man and domestic animals has largely been prepared by the junior author owing to the death of the senior author in the early stages of the work. The arrangement of the ninth edition [*R.A.E.*, B **44** 79] has been followed almost entirely, but many sections, including the chapters on arthropods, have been largely rewritten to incorporate newly acquired knowledge. As far as possible, new and up-to-date systems of classification have been adopted throughout. The lists of references have been revised.

PAPERS NOTICED BY TITLE ONLY.

DOUCET (J.), ADAM (J. P.) & BINSON (G.). **Les Culicidae de la Côte d'Ivoire** [ecological distribution of 26 species of *Anopheles* and 98 species of Culicines].—*Ann. Parasit. hum. comp.* **35** no. 3 pp. 391–408, 2 maps, 14 refs. Paris, 1960. (With a summary in English.)

HOPKINS (G. H. E.). **Insects of Micronesia. Vol. 14 no. 4. Siphonaptera.**—pp. [3 +] 91–107, 9 figs., 1 map. Honolulu, Bishop Mus., 1961. [*Cf. R.A.E.*, B **45** 87; **48** 188.]

TILL (W. M.). **A contribution to the anatomy and histology of the brown ear tick** *Rhipicephalus appendiculatus* **Neumann.**—*Mem. ent. Soc. S. Afr.* no. 6, 124 [+ 1] pp., 49 pls., 6 pp. refs. Pretoria, 1961.

HIROYOSHI (T.). **Some new mutants and linkage groups of the house fly** [*Musca domestica* L.].—*J. econ. Ent.* **53** no. 6 pp. 985–990, 1 fig., 8 refs. Menasha, Wis., 1960.

ZUMPT (F.). Ed. **The arthropod parasites of vertebrates in Africa south of the Sahara (Ethiopian Region). Volume I (Chelicerata).**—*Publ. S. Afr. Inst. med. Res.* no. 50, $10\frac{1}{4} \times 7\frac{3}{4}$ in., [9+] 457 pp., 248 figs., $6\frac{1}{2}$ pp. refs. Johannesburg, 1961. Price *R*.6.

This systematic account of the mites parasitic on vertebrates (other than fish) in the Ethiopian region, is the first volume of a work intended to replace Bedford's check-list [*R.A.E.*, B **25** 152, etc.], which has for long been out of print and is out of date for most groups. It will, however, be much wider in scope, including hosts and parasites from the whole of the Ethiopian region (excluding Madagascar) and endoparasitic as well as ectoparasitic arthropods. The manuscript of the present volume was closed at the end of 1958, but a few later records have been added. There are introductory chapters on arthropod parasitism and its evolution and on the collection and preservation of parasitic arthropods. Keys to genera and lists of species with synonyms and information on hosts and distribution are given for the suborders Mesostigmata, Trombidiformes and Sarcoptiformes of Acarina and the order Pentastomida. A host-parasite list is appended. The Ixodoidea are to be dealt with separately in Volume II.

ROTH (L. M.) & WILLIS (E. R.). **The biotic associations of cockroaches.**—*Smithson. misc. Coll.* **141** (Publ. 4422), vi+470 pp., frontis., 36 pls., 7 figs., 84 pp. refs. Washington, D. C., 1960.

Information, mainly from the literature but occasionally from unpublished records and observations, is given on the ecology of different species of cockroaches throughout the world and on the viruses and various organisms that have been found in association with them. Chapters are also included on cockroaches as commensals and predators, associations among cockroaches, their means of defence against predators and their biological control, and there is a check-list of over 100 species of cockroaches and their symbiotic associates.

LAARMAN (J. J.). **Research on the ecology of Culicine mosquitoes in a forest region of the Belgian Congo.**—*Acta leidensia* **28** pp. 94–98. Leiden, 1958. (With a summary in French.)

LAMBRECHT (F. L.) & ZAGHI (A.). **Observations sur la ponte des Culicides dans la forêt ombrophile d'Irangi, Congo Belge.**—*Rev. Zool. Bot. afr.* **61** fasc. 1–2 pp. 87–97, 1 graph, 3 refs. Brussels, 1960.

The observations described in these two papers were carried out round the field laboratory of Irangi, in a small humid area of forest with no marked dry season at an altitude of about 2,600 ft. in the east of the Belgian Congo.

The study dealt with in the first paper, which was begun in September 1955, showed that Anophelines were poorly represented, two stream-breeders, *Anopheles vinckei* De Meillon and *A. cinctus* (Newst. & Cart.), being the most abundant. *A. gambiae* Giles was not found in the forest, as it was by Haddow [*R.A.E.*, B **35** 68], but occurred in a plantation area and was occasionally taken near a road. Large numbers of Culicine larvae were obtained from bamboo pots fixed in trees to provide artificial breeding places; about 80 per cent. of these contained larvae, and this was taken to indicate a lack of suitable natural sites. *Aëdes africanus* (Theo.) and *A. apicoargenteus* (Theo.) showed a preference for lower levels, contrary to Haddow's experience [**35** 68; **49** 211] and the latter had an outstanding preference for the open. *A. simpsoni* (Theo.) bred abundantly in the leaf axils of bananas, but no larvae of this species were found in the leaf axils of *Pandanus* in an area in which it was very plentiful close to bananas, although many other Culicine larvae were found in them. *A. simpsoni* came readily to human bait but not to monkeys.

The second paper contains detailed results of supplementary observations made in 1957–58 on larval ecology in natural and artificial breeding places and on oviposition activity throughout the 24-hour period. Larvae found included representatives of five species of *Anopheles*, all taken in rivers only.

Sømme (L.). **Resistance to organophosphorus insecticides in Norwegian house flies.**—*Norsk ent. Tidsskr.* **11** pt. 3–4 pp. 150–159, 1 graph, 14 refs. Oslo, 1960.

Organophosphorus insecticides, mainly in the form of parathion-impregnated gauze strips, have been widely used for fly control on Norwegian farms since 1954–55 [*cf. R.A.E.*, B **48** 85–86], but the strips appeared to be losing their effectiveness in 1958. Collections of house-flies (*Musca domestica* L.) were therefore made in south-eastern Norway during the autumn of 1958 on two farms and during the autumn of 1959 on nine farms on which the strips had been used for 2–4 years, and the susceptibility of the second-generation female progeny to parathion, malathion, diazinon and trichlorphon was tested by topical application. The LD50's showed the field-collected strains to be 2–5 times as resistant to parathion, 2–6 times as resistant to diazinon and malathion and 2–4 times as resistant to trichlorphon as a susceptible laboratory strain. At the LD90 level, resistance was usually slightly higher. Four strains were further selected in the laboratory. Two selected with trichlorphon became 17–18 times as resistant as the laboratory strain at the LD50 level and 35 and 56 times at the LD90 level. Selection with parathion and malathion increased resistance to the selective agent from 5 to 8·5 times and from 4 to 6 times, respectively, at the LD50 level as compared with the laboratory strain. No definite patterns of cross-resistance could be found in the strains, but it is considered likely that low levels of resistance to several organophosphorus compounds would develop as a result of selection with one of them. There are indications that resistance to organophosphorus poisoning tends to fall rapidly when selection is discontinued, so that it is possible that the field-collected flies were more resistant than the second-generation progeny used for initial testing. During selection, some of the strains showed considerable heterogeneity towards the insecticides, which probably arose from different genetical constituents in the flies.

Burden (G. S.) & Eastin (J. L.). **Field tests of dusts and sprays against German cockroaches.**—*Florida Ent.* **43** no. 1 pp. 15–18, 6 refs. Gainesville, Fla., 1960.

When tested as spot treatments for the control of *Blattella germanica* (L.) in houses in Florida, sprays containing 0·5 per cent. diazinon or 2 per cent. malathion, dicapthon or fenchlorphos (ronnel), prepared from emulsion concentrates, gave good (90 per cent. or more) reduction of infestation for two months, and diazinon and malathion were still giving 99 and 95 per cent. reduction, respectively, after three months. Trichlorphon (Dipterex) at 2 per cent. in water and Thiodan at 0·5 per cent. in an emulsion spray were less effective, and barthrin [6-chloropiperonyl chrysanthemate] at 5 per cent. in an emulsion was much inferior to either. The best four compounds were re-tested as dusts. Diazinon at 1 per cent. gave 87 per cent. or more reduction for two months, but was unsatisfactory after three months. Dicapthon and fenchlorphos at 4 per cent. gave good reductions for 12–13 days, but decreased in effectiveness after that time. A 4 per cent. malathion dust was never satisfactory. The males of 75 per cent. of the strains of *B. germanica* collected showed resistance to chlordane, but none showed any to diazinon or malathion.

WILSON (H. G.) & LABRECQUE (G. C.). **Tests with larvicides for the control of house flies in poultry houses.**—*Florida Ent.* **43** no. 1 pp. 19–21, 2 refs. Gainesville, Fla., 1960.

As several compounds, including diazinon, that had been in use for the control of *Musca domestica* L. and *Hermetia illucens* (L.) breeding in poultry droppings under fowl houses in Florida [*R.A.E.*, B **47** 146] were showing signs of greatly decreased effectiveness, eight further compounds were tested as larvicides against *M. domestica* breeding in droppings under caged poultry in the Orlando area. They were applied at rates ranging from 150 to 1,000 mg. per sq. ft., in 1–4 U.S. gal. spray or 2–3 lb. dust or granules per 1,000 sq. ft. Fenthion (Baytex) was effective in all three formulations at the lowest dosages, giving good control for 2–7 days at 150–300 mg. per sq. ft. The other materials, which included dusts of Polybor 3 (disodium octaborate tetrahydrate) [*cf.* **49** 188, etc.] and thiourea [*cf.* **48** 137], were ineffective at these dosages, but calcium arsenate in suspension gave good control for 3–4 days at 600–1,000 mg. per sq. ft.

HART (R. J.). **Susceptibility of *Lucilia cuprina* Wied. to some organic phosphorus compounds.**—*J. Aust. Inst. agric. Sci.* **26** no. 1 pp. 70–71, 3 refs. Sydney, 1960.

Diazinon has recently been extensively used for the prevention of blowfly infestation of sheep as an alternative to insecticides to which *Lucilia cuprina* (Wied.) had become resistant in Australia [*cf.* *R.A.E.*, B **48** 134–135]. Tests were therefore carried out to ascertain the LD50's of diazinon and other organophosphorus compounds to females of a susceptible laboratory strain topically treated with oil solutions of insecticide while immobilised with carbon dioxide and then kept at 77°F. for 24 hours. In μg. per insect, the LD50's were determined as 0·042 for diazinon, 0·031 for fenchlorphos (Trolene), 0·037 for parathion, 0·406 for malathion and 0·027 for dimethoate (Rogor).

HALL (W. T. K.) & WILKINSON (P. R.). **Observations on survival of cattle tick, *Boophilus microplus* (Can.) in north Queensland.**—*Qd J. agric. Sci.* **17** no. 2 pp. 91–96, 2 graphs, 11 refs. Brisbane, 1960.

In a preliminary study of the survival of *Boophilus microplus* (Can.) near Townsville, northern Queensland, made with a view to formulating plans for improved control by carefully timed dipping or destocking of pasture [*cf.* *R.A.E.*, B **47** 176], engorged female ticks in gauze cylinders were put in tussocks of guinea grass (*Panicum maximum*) on 14 occasions between July 1956 and July 1957. Weekly observations were made on the development period of the eggs and on the survival of the larvae, which were allowed to escape on to grass blades as soon as they were seen to have hatched.

The longest survival period, from the putting out of the parent female ticks to the death of all larvae, was 19 weeks, for a test begun on 15th March, and the shortest about nine weeks, for one begun on 14th December. The developmental period of the egg varied from three weeks in summer to ten weeks in winter. The females put out on 22nd February were flooded for 24 hours in early March, and many of their eggs failed to hatch.

The relevance of the findings to tick control in the Townsville area is discussed, and it is concluded that temporary destocking should be considered as a possible method; it will probably be many years before the advantages and disadvantages can be adequately assessed.

Korshunova (O. S.), Piontkovskaya (S. P.) & Nikitina (N. A.). **On natural nidi of Asian tick-borne spotted fever in Khakassia and in the central part of the western Sayan mountains.** [*In Russian.*]—*Zool. Zh.* **38** pt. 3 pp. 385–393, 1 fig., 11 refs. Moscow, 1959. (With a summary in English.)

The following is based on the authors' summary. Investigations in May–June 1956 at four isolated points in the districts concerned, which are in Siberia and far from the nearest previously known focus of Asian tick-borne spotted fever (tick typhus) (caused by *Rickettsia sibirica*), showed that natural nidi of the disease [*cf. R.A.E.*, B **32** 220; **40** 215] occurred in all of them. *Dermacentor nuttalli* Olen. was the only ectoparasite present on cattle, and it also occurred on grassland and roadsides. *R. sibirica* was isolated from adults of this tick and from various small mammals, largely rodents, lists of which are given.

Pervomaĭskiĭ (G. S.) & Maklȳgin (M. V.). **Activity of attachment of the tick *Hyalomma asiaticum asiaticum* P. Sch. et E. Schl. in laboratory conditions.** [*In Russian.*]—*Zool. Zh.* **38** pt. 3 pp. 394–400, 3 figs., 13 refs. Moscow, 1959. (With a summary in English.)

The following is based on the authors' summary. Under suitable conditions, adults of *Hyalomma asiaticum asiaticum* Schulze & Schlottke actively attached themselves to laboratory animals, the degree of activity depending on the preceding hunger period, the time of year, and the species and condition of the host. Previously unfed adults only 7–20 days old did not become attached readily, but their activity was increased by exposure to 40°C. [104°F.] for three days. Once the ticks were on their host, variations of temperature from 10 to 35°C. [50 to 95°F.] and in relative humidity from 60 to 85 per cent. had no effect on attachment. Other conditions being equal, activity of attachment was greater in spring than in winter. When an individual host was used more than once, the ticks fed for a longer time, but ingested less blood. Attachment to man was observed under laboratory conditions.

Gutsevich (A. V.) & Podolyan (V. Ya.). **A study of mosquitos in relation to their rôle as vectors of neurotropic viruses in the west of the Ukraine.** [*In Russian.*]—*Zool. Zh.* **38** pt. 3 pp. 443–448, 17 refs. Moscow, 1959. (With a summary in English.)

In view of the isolation of the virus of lymphocytic choriomeningitis from mosquitos in the west of the Ukraine [*R.A.E.*, B **47** 70], a list is given of

21 species, including 13 species of *Aëdes*, taken in the Cis- and Trans-carpathian districts in 1957–58, with notes on their seasonal frequency and the techniques employed for collecting and preparing them for virological tests.

Kovaleva (R. V.) & Gershkovich (N. L.). **A new spontaneous vector of plague—the flea** *Leptopsylla taschenbergi* **Wagn. (1898).** [*In Russian.*]—*Zool. Zh.* **38** pt. 3 pp. 489–490, 2 refs. Moscow, 1959. (With a summary in English.)

In the course of a plague epizootic among mice (*Mus musculus*) in coastal districts of the Gurev region, on the Caspian Sea, in the spring of 1958, two strains of plague bacilli were isolated from fleas of the species *Leptopsylla taschenbergi* (Wagn.), which are common on these mice. *Ceratophyllus mokrzeckyi* Wagn. was also found naturally infected.

British Standard 1831:1961. Recommended common names for pesticides.—52 pp. London, Brit. Stand. Instn., 1961.

In addition to a list of the common names approved for pesticides (classified as insecticides or acaricides, fungicides, herbicides and rodenticides) by the British Standards Institution, showing the chemical names and formulae of the compounds concerned and other, non-proprietary names that have been applied to them, this revised British Standard includes a list of common names considered by the International Organization for Standardization but not recommended in the British Standard, a list of chemicals not requiring common names, and an alphabetical index to the whole. With regard to the recent supplementary list of common names published for use in this *Review* [*R.A.E.*, B **49** 1–2], it will be noted that the common name finally accepted in the British Standard for the herbicide there cited as 2-chloro-6-diethylamino-4-isopropylamino-1,3,5-triazine [*cf.* **49** 2] is ipazine, and not prodizine.

Peterson (D. G.) & West (A. S.). **Control of adult black flies (Diptera: Simuliidae) in the forests of eastern Canada by aircraft spraying.**—*Canad. Ent.* **92** no. 9 pp. 714–719, 2 figs., 7 refs. Ottawa, 1960.

On 8th July 1954, an 11 per cent. (w/v) solution of DDT in furnace oil was applied from a light aircraft fitted with a rotary-brush emission assembly to a village near Baie Comeau on the north shore of the St. Lawrence, in eastern Quebec and an area of 6·7 sq. miles surrounding it, for the control of adult Simuliids. *Simulium venustum* Say was the principal pest species present. A dosage of 0·19 lb. DDT per acre significantly reduced the adult Simuliid population for the remainder of that year to a level well below that at which it is considered a nuisance. An application of the same spray at 0·22 lb. DDT per acre to an area of 10 sq. miles on 6th July 1956, by two Stearman biplanes fitted with boom-spray assemblies, satisfactorily reduced the number of Simuliids for a period of more than ten days. Seasonal changes in activity and those associated with weather make it impracticable to express the effectiveness of the treatment in quantitative terms. Weather was unfavourable to the Simuliids in both years.

McKiel (J. A.) & Clunie (J. C.). **Chromatographic fractionation of the non-dialyzable portion of mosquito extract and intracutaneous reactions of mosquito-bite-sensitive subjects to the separated components.**—*Canad. J. Zool.* **38** no. 3 pp. 479–487, 2 figs., 8 refs. Ottawa, 1960.

The following is based on the authors' abstract and summary. Extracts of adults and larvae of *Aëdes aegypti* (L.) and of adults of *A. atropalpus* (Coq.) and *Culex restuans* Theo. were each shown by paper chromatography to contain 12 ninhydrin-staining peptides. These peptides, separated from an extract of adults of *A. aegypti* by water-poor solvent systems, did not cause skin reactions in a volunteer sensitive to bites of this species. A reaction equivalent to that caused by a mosquito bite was produced by an estimated 10^{-3} μg. of dialysed extract of *A. aegypti* from which the ninhydrin-staining peptides had been removed. Of the water-rich solvent systems tested in attempts to fractionate this active material, the most suitable was 65 per cent. acetone in water, and extracts of *A. aegypti* made with it contained at least four fractions capable of producing skin reactions in volunteers sensitive to bites of *A. aegypti*.

Wolfe (L. S.) & Peterson (D. G.). **Diurnal behavior and biting habits of black flies (Diptera: Simuliidae) in the forests of Quebec.**—*Canad. J. Zool.* **38** no. 3 pp. 489–497, 3 graphs, 15 refs. Ottawa, 1960.

The following is virtually the authors' abstract. Studies in the region of Baie Comeau, Quebec, from 1954 to 1956, showed that Simuliids were most active in the morning 1–2 hours after dawn and in the evening ½–1 hour before sunset. Flight activity appeared to depend on light intensity, provided that the temperature was not below 45°F. [*cf. R.A.E.*, B **42** 181], the wind velocity not above 2 miles per hour and the relative humidity not below 50 per cent. In the morning, activity was greatest at higher levels of light intensity, *i.e.*, 20 foot-candles, than in the evening, 5 foot-candles. Activity increased before thunder-storms and rain, and the increase appeared related more to the change in light intensity than to changes in atmospheric pressure or humidity. At night, Simuliids moved to resting places in the tops of the trees, probably because of the more suitable light intensity at the higher levels just before dark. Oviposition began in the late afternoon and continued until dark except on overcast days, when it began in the early afternoon. *Simulium venustum* Say, the commonest species, bit man mainly on the back of the neck.

Downe (A. E. R.). **Blood-meal sources and notes on host preferences of some *Aedes* mosquitoes (Diptera: Culicidae).**—*Canad. J. Zool.* **38** no. 4 pp. 689–699, 26 refs. Ottawa, 1960.

The blood-meals of engorged females of various species of *Aëdes* collected in Ontario in 1955–57 from farm buildings and light-traps and with sweep nets near farms and in wooded areas were identified by precipitin tests. The species collected in greatest abundance were *A. trichurus* (Dyar), *A. stimulans* (Wlk.), *A. excrucians* (Wlk.), *A. punctor* (Kby.) and *A. communis* (Deg.). Females of all these had obtained meals from cattle, horses and pigs and from man; some females of most had fed on rodents and other wild animals, but very few had fed on birds, and few contained the blood of more than one kind of host. Preliminary studies with various combinations of domestic animals and man in a screened enclosure in a one-roomed building indicated that apparent preferences shown by mosquitos for certain mammalian hosts over others generally depend on the total surface area of host available.

FREDEEN (F. J. H.) & SHEMANCHUK (J. A.). **Black flies (Diptera: Simuliidae) of irrigation systems in Saskatchewan and Alberta.**—*Canad. J. Zool.* **38** no. 4 pp. 723–735, 2 pls., 1 map, 13 refs. Ottawa, 1960.

The following is virtually the authors' summary. The immature stages of *Simulium vittatum* Zett., *S. venustum* Say, *S. meridionale* Ril., *S. tuberosum* Lndst., *S. decorum* Wlk., *S. bivittatum* Mall., *S. griseum* Coq., *S. arcticum* Mall. and *S. aureum* Fries, in order of decreasing abundance, occurred in 79 per cent. of 341 collections from 69 irrigation canals and 18 adjacent rivers and streams in irrigated areas of southern Saskatchewan and Alberta in the years 1950 to 1958. Canals less than four years old were infested despite a scarcity of aquatic vegetation, which formed the main attachment sites. Factors reducing larval abundance included interruption of flow, lack of food and attachment sites, parasites, invertebrate and vertebrate predators, and possibly insecticides from irrigated crops. In some canals, up to 100 per cent. of the larvae of *S. vittatum* were infested with nematodes, *Hydromermis* sp., which prevented pupation. Other larvae were infected with Microsporidia. Most canals were dry in the winter. Only larvae of *S. vittatum* overwintered in two canals that flowed all the winter; no viable overwintered eggs of any species were found in any canals. It is presumed that canals are reinfested each spring by gravid females migrating from permanent breeding sites, mainly in the larger streams and rivers. Although Simuliids, especially *S. vittatum*, were occasionally abundant and all are blood feeders, they were generally less of a nuisance than mosquitos. *Leucocytozoon*, which is transmitted by Simuliids [*R.A.E.*, B **48** 54], was reported occasionally to occur in turkeys in the area.

MORRIS (K. R. S.). **The epidemiology of sleeping sickness in East Africa. Part I. A sleeping sickness outbreak in Uganda in 1957.**—*Trans. R. Soc. trop. Med. Hyg.* **53** no. 5 pp. 384–393, 2 maps, 6 refs. London, 1959.

The following is almost entirely taken from the author's summary. In 1957, an epidemic of sleeping sickness caused by *Trypanosoma gambiense*, with *Glossina palpalis* (R.-D.) as the vector, broke out on the Aswa River, draining the Lango and Acholi Districts of Uganda. The disease first appeared on this river over 20 years ago, following a series of epidemics, each one caused by a big movement of people including infected persons, which had traversed Acholi from west to east and originated in an outbreak on the Albert Nile in 1909. Two previous outbreaks had occurred on the Aswa River close to the site of the present epidemic; one, in 1935, resulted from the first introduction of the disease, and one, in 1945, followed an abnormal increase in man-fly contact during an exceptionally dry season. Data are given showing the remarkably rapid development of the 1957 epidemic, in which a tenfold increase in the number of cases took place in 18 months. The causes of the outbreak are discussed. A dense human population was occupying a part of the tsetse-infested river where the contact with *G. palpalis* was so close as to be almost inescapable. The absence of other food for the fly, and the people's habits of fishing and travelling, tended to increase the intensity and amount of their contact with the tsetse. Finally, a very dry season in 1956–57 aggravated still further this close man-fly contact and caused an existing low endemic of *T. gambiense* to flare up at the alarmingly rapid rate recorded. Control, by mass survey and treatment of cases combined with a temporary and local elimination of *G. palpalis* by the spraying of waterside vegetation over 76 miles of the main river and 230 miles of tributary streams with 5 per cent. (w/v) dieldrin, kept the epidemic from developing into what might have been a dangerously wide outbreak, but the actual rate of reduction in the epidemic centre was slow. The underlying reasons are discussed.

Ashcroft (M. T.). **The sex ratio of infected flies found in transmission experiments with** *Glossina morsitans* **and** *Trypanosoma rhodesiense* **and** *T. brucei.—Trans. R. Soc. trop. Med. Hyg.* **53** no. 5 pp. 394–399, 14 refs. London, 1959.

The following is based on the author's summary. In transmission experiments in Tanganyika with *Glossina morsitans* Westw., in which one strain of *Trypanosoma rhodesiense* and two strains of *T. brucei* were used, the proportion of male flies becoming infected was greater than that of females [*cf. R.A.E.*, B **37** 136; **46** 191]. In all experiments, female flies died sooner than males, though it seems well established that females usually live longer than males in nature [*cf.* **37** 137, etc.]. It is suggested that conclusions derived from laboratory experiments may not be applicable to natural conditions.

Woodall (J. P.) & Bertram (D. S.). **The transmission of Semliki forest virus by** *Aedes aegypti* **L.**—*Trans. R. Soc. trop. Med. Hyg.* **53** no. 6 pp. 440–444, 5 refs. London, 1959.

Semliki forest virus was first isolated from a pool of mosquitos of the group of *Aëdes abnormalis* (Theo.) [*R.A.E.*, B **34** 87], and although exploratory investigations suggested that *A. aegypti* (L.) was unlikely to transmit it [**34** 88], this species was subsequently shown to do so over a short period [**43** 65–66]. An account of experiments in which *A. aegypti* proved to be an efficient vector is given in this paper. Unfed females, 1–5 days old, were allowed to engorge on week-old mice into which virus had been injected intraperitoneally about 24 hours earlier. They were then kept at 30°C. [86°F.] and 80 per cent. relative humidity for varying periods before being given access for 10–180 minutes to similar normal mice. Of 84 mice so exposed to the bites of, usually, 1–5 mosquitos, 55 became infected. Virus was transmitted every day from 2 to 15 days after the infecting feed and occasionally thereafter at least until the 46th day. Engorgement, or even probing only, of a single mosquito was sometimes sufficient to effect transmission. The finding of virus in the salivary glands after 48 hours indicated that transmission at this time was cyclical. No virus was detected in the salivary glands 24 hours after the infecting feed [*cf.* **43** 65], but mechanical transmission was effected when mosquitos were fed on healthy mice 24 hours after their infective meal as well as when this meal was interrupted. Mechanical transmission may possibly continue for several days under certain conditions.

Chamberlain (R. W.), Sudia (W. D.) & Gillett (J. D.). **St. Louis encephalitis virus in mosquitoes.**—*Amer. J. Hyg.* **70** no. 3 pp. 221–236, 3 graphs, 21 refs. Baltimore, Md., 1959.

Culex tarsalis Coq. is recognised as the most important vector of St. Louis encephalitis (SLE) in the western United States [*R.A.E.*, B **41** 127, etc.], and few isolations of the virus have been made from other species. However, several epidemics have occurred in central States in areas in which *C. tarsalis* was scarce or absent [*cf.* **47** 123] but *C. pipiens pipiens* L. or *C. p. fatigans* Wied. (*quinquefasciatus*, auct.) (which the authors treat as a distinct species) was abundant, and the virus has been found in both these mosquitos [*cf.* **43** 133; **47** 7; **49** 137]. Nevertheless, the distribution of the disease is discontinuous over their range. To provide a better understanding of vector relations, the efficiencies as vectors of SLE virus of eight geographical strains of *C. p. fatigans*, two of *C. p. pipiens* and one of *C. p. molestus* Forsk. (treated as an additional strain of *pipiens*) and 11 other species of mosquitos of six genera were tested and compared by quantitative laboratory methods. Most of the mosquitos were infected by feeding on chickens with virus circulating in their blood. All species and strains of *Culex* tested were found to be highly susceptible to infection and effected transmission to healthy chickens with 100 per cent. efficiency or nearly so. Species of *Aëdes*, *Psorophora*, *Anopheles*, *Mansonia* and *Wyeomyia* were relatively non-susceptible and usually failed to transmit.

Incubation of the virus took considerably longer in *C. p. fatigans* than it did in *C. p. pipiens*, 100 per cent. transmission occurring on the 12th day in the latter but only after 19–26 days in the former, at 80°F. It is possible that the shorter period needed in *pipiens* may be the result of increased metabolic activity at 80°F. in a mosquito that normally inhabits cooler latitudes. Attempts to demonstrate transovarian passage of SLE virus, a possible reservoir mechanism in nature, all failed. The results of the studies strongly support epidemiological evidence of *C. p. fatigans* and *C. p. pipiens* as important vectors of urban St. Louis encephalitis in the central part of the United States. Possible reasons are discussed for their relative lack of importance in the far west, where the disease is mainly rural, and since no obvious differences were found in the readiness of the various strains to attack man, it is thought that a slightly lower infection threshold [**44** 38] in *C. tarsalis* may have been significant; it is suggested that the apparent ready infection of *C. p. pipiens* and *C. p. fatigans* in the central States may be due to the production there of strains of the virus producing higher viraemias, of which there is some evidence in wild birds in Kentucky, these strains being the only ones perpetuated in the absence of *C. tarsalis*, whereas such selection does not operate where this species predominates.

Sudia (W. D.). **The multiplication of St. Louis encephalitis virus in two species of mosquitoes:** *Culex quinquefasciatus* **Say and** *Culex pipiens* **Linnaeus.**—*Amer. J. Hyg.* **70** no. 3 pp. 237–245, 3 graphs, 15 refs. Baltimore, Md., 1959.

The following is substantially the author's summary. A study was made of the behaviour of the virus of St. Louis encephalitis (SLE) after injection into the thorax of *Culex pipiens pipiens* L. and *C. p. fatigans* Wied. (*quinquefasciatus*, auct.), which are treated as distinct species. A microcapillary pipette was used to inject various concentrations of the virus into the mosquitos. They were then killed by freezing at once or after seven specific intervals up to 144 hours, and the concentrations of virus in individual mosquitos were determined. Other groups were similarly treated, and their ability to transmit by bite was tested after incubation periods of 3–12 days. The ratio of the intracerebral LD50 for mice three weeks old to the LD50 for the mosquitos was found to be 10–25:1. After injection of SLE virus at the rate of 0·7 mouse LD50 per mosquito, detectable levels ($10^{1\cdot1}$ LD50) were reached in *C. p. pipiens* in 48 hours and in *C. p. fatigans* in 60 hours. Once a detectable level had been attained, the rate of increase appeared to be about 10- to 30-fold each 12 hours in both mosquitos until a peak of about 10^6 mouse LD50's was reached. When a higher concentration of virus was injected, less time was required for the virus to reach peak titres in the mosquitos. The same high level was eventually reached, however, regardless of the concentration given. In the transmission studies, all mosquitos of both subspecies transmitted virus to chicks within only four days of the injection of a relatively large amount of virus (330 mouse LD50's), and even after injection of a low concentration (0·1 mouse LD50), 100 per cent. transmission was achieved by *C. p. pipiens* within six days and by *C. p. fatigans* in eight. These data, taken in conjunction with the fact that similar transmission rates were not reached until the 12th day in *C. p. pipiens* and between the 19th and 26th days in *C. p. fatigans* when infection was by ingestion [see preceding abstract], suggest that the tissues of the digestive tract delay the movement of the virus to the salivary glands.

Chock (Q. C.), Davis (C. J.) & Chong (M.). *Sepedon macropus* (**Diptera: Sciomyzidae**) **introduced into Hawaii as a control for the liver fluke snail,** *Lymnaea ollula.*—*J. econ. Ent.* **54** no. 1 pp. 1–4, 3 refs. Menasha, Wis., 1961.

The intermediate host of the liver fluke, *Fasciola gigantica*, the most important parasite of beef and dairy cattle in Hawaii, is *Lymnaea* (*Fossaria*) *ollula*, and *Pseudosuccinea columella* has been shown to be a vector under laboratory conditions; both snails are found in streams, taro patches and swamps, and a predacious Sciomyzid, *Sepedon macropus* Wlk., was introduced for their control. Insectary tests showed that the egg, larval and pupal stages and life-cycle of this insect lasted 3, 11–12, 7–8 and 22–24 days and the preoviposition stage 4–5 days. The adults lived longer and produced more eggs when crushed snails were provided as food; when three samples were provided with honey and water, crushed snails and water and crushed snails, honey and water, respectively, nine pairs of flies produced 184, 2,725 and 14,824 eggs and the average periods lived by the females and (in brackets) by the males were 48 (50), 27 (21) and 69 (103) days. Two methods of rearing, an initial one to assure a nucleus of breeding stock and the other for mass production, are described. Releases made on the five main islands between December 1958 and May 1959 totalled over 7,600 flies, and recovery was reported from Oahu and Kauai. On Oahu, catches of 49–200 flies were made in traps baited with crushed snails and exposed for half an hour daily on four days in December 1959, and this indicates the adaptability of the species to Hawaiian conditions; it seems likely that it may give important help in the control of *F. gigantica*.

Dorough (H. W.), Brady jr. (U. E.), Timmerman jr. (J. A.) & Arthur (B. W.). **Residues in tissues and eggs of poultry dusted with Co-Ral (Bayer 21/199).**—*J. econ. Ent.* **54** no. 1 pp. 25–30, 1 graph, 12 refs. Menasha, Wis., 1961.

Coumaphos (Co-Ral) has been used successfully for the control of poultry pests [*cf. R.A.E.*, B **49** 33, 79], and studies were undertaken to determine the amount of the compound remaining in the tissues and eggs of hens dusted once or twice at an interval of a week with coumaphos labelled with ^{32}P at the rate of 50 mg. per kg. body weight, and to identify its metabolites in their droppings. The following is based mainly on the authors' abstract. After treatment of the hens, eggs and droppings were collected daily, and 2–3 hens were slaughtered at predetermined intervals. Three days after either treatment, less than half the amount of coumaphos applied remained on the feathers and skin of the hens but some intact coumaphos remained for 28 days. Of the internal tissues, the liver, kidney and bone contained the highest accumulation of radioactive materials, of which very little was stored in the fat. One week after treatment, less than 0·02 part per million could be detected in the blood or brains of hens dusted either once or twice. Within three days of treatment, acetonitrile-soluble residues, which represent only a small portion of the total, were negligible (less than 0·02 p.p.m.) in the internal tissues, but there were minute amounts in the eggs 5–7 days after one application and 1–5 days after two. These residues were not identified as either coumaphos or its oxygen analogue, O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphate. The extractable radioactive materials in the droppings consisted of residual coumaphos, the oxygen analogue, diethyl phosphoric acid and O,O-diethyl phosphorothioic acid. Phospholipids, ribose nucleic acid, desoxyribose nucleic acid and acid-soluble phosphorus compounds were isolated from the unextractable radioactive residues from the liver and droppings. No symptoms of poisoning were noticed in any of the treated hens, and egg-production and feed consumption were not affected.

Harris (R. L.), Wearden (S.) & Roan (C. C.). **Preliminary study of the genetics of housefly** (*Musca domestica*) **resistance to malathion.**—*J. econ. Ent.* **54** no. 1 pp. 40–45, 2 graphs, 14 refs. Menasha, Wis., 1961.

Resistance of *Musca domestica* L. to malathion has been reported [*R.A.E.*, B **47** 85; **48** 123] and the following is based mainly on the authors' summary of the results of studies of the inheritance of this resistance in two strains, one susceptible (JSS) and one resistant (JRR), derived by selection of the offspring of individual females from a field strain (JUN) slightly resistant to malathion, which was collected at the Juniata ranch, Manhattan, Kansas. The responses of the strains to malathion were determined by observing mortality in females 24 hours after topical application of the toxicant in acetone solution. LD50 values showed the JUN strain to be 1·7 times, and the JRR strain 62 times as resistant as the JSS strain. The JRR strain was less prolific and slower in its development from egg to adult than the JSS strain. Both produced the sexes in equal numbers, but in the JSS strain the males emerged significantly earlier than the females.

Reciprocal crosses between the JSS and the JRR strains gave F_1 and F_2 hybrids of which half were resistant and half susceptible; this segregation in the F_1 generation cannot be explained on the basis of a single gene for resistance, nor on that of independent assortment of multiple genes, since the JRR strain was a homogeneous malathion-resistant population. The most plausible explanation is that malathion resistance is controlled by two pairs of alleles, and that the presence in an individual of two genes for resistance causes it to show the character, whether these are members of the same pair of alleles or not. The JSS strain was homozygous for the absence of both genes, since no resistant individuals were detected, and if the JRR strain was homozygous for one and heterozygous for the other, the observed distribution of resistance in the F_1 generation would be explained. The expected results in this generation for either independent assortment or close linkage of these alleles are so similar that no conclusions as to their loci can be drawn.

The F_1 offspring of resistant females and susceptible males are more resistant than the reciprocal cross, suggesting a maternal effect, but this was not seen in the F_2 generation, so that sex-linkage cannot be involved.

Gahan (J. B.), LaBrecque (G. C.) & Wilson (H. G.). **Hercules AC-5727 as a residual spray for adult mosquitoes.**—*J. econ. Ent.* **54** no. 1 pp. 63–67, 2 refs. Menasha, Wis., 1961.

In view of the increasing frequency of reports of resistance to DDT and dieldrin in *Anopheles*, an extensive programme of tests was begun at Orlando, Florida, to find materials that are more effective than the chlorinated hydrocarbons. The following is based mainly on the authors' abstract of the results of part of this programme. Adults of *Aëdes taeniorhynchus* (Wied.), *A. aegypti* (L.) and *Anopheles albimanus* Wied. and of a strain of *A. quadrimaculatus* Say that had developed a high level of resistance to dieldrin in the laboratory were found to be highly susceptible to Hercules AC-5727 (m-isopropylphenyl methylcarbamate) by exposure for one or five minutes on plywood panels sprayed 3–10 days before with acetone solutions of the compound affording 100 mg. per sq. ft. Exposure for 60 or 120 minutes on panels 20 weeks after their treatment at rates as low as 1 or 10 mg. per sq. ft. caused 75–100 per cent. mortality of *A. quadrimaculatus*. In similar tests with this mosquito, Hercules AC-5727 was more effective than DDT, malathion, dieldrin or fenthion (Bayer 29493). The outstanding characteristic of the carbamate is its very rapid action, for an exposure of one minute to deposits of 100 mg. per sq. ft. consistently produced complete knockdown within 5–10 minutes for one month. Tests in which adults of *A. quadrimaculatus* were exposed for one hour to baked red clay, either plain or whitewashed, or sun-dried red brick treated with malathion, DDT or the carbamate at 100 mg. per sq. ft. showed that all compounds remained highly effective on plain clay for the 12 weeks of the test, but that none had long residual toxicity on the other two surfaces. In small wooden buildings naturally infested with *A. quadrimaculatus*, Hercules AC-5727 or DDT, sprayed on the walls and ceilings at a rate of 100 mg. per sq. ft., gave 97–100 per cent. control for 18 weeks, whereas malathion at the same rate gave similar control for only ten weeks.

Harshbarger (J. C.) & Raffensperger (E. M.) **An evaluation of coding systems for estimating populations of the shaft louse,** *Menopon gallinae*.—*J. econ. Ent.* **54** no. 1 pp. 74–76, 21 refs. Menasha, Wis., 1961.

Various techniques have been proposed for estimating the degree of infestation of fowls by *Menopon gallinae* (L.). The numbers of lice on 79 hens were estimated by four methods and compared with the actual numbers removed from each bird. Of the four methods, the most accurate was that developed by the authors, by which the numbers of lice seen in one minute were classified into one of six ratings ranging from 0 to 101–125, although one based on rough estimates of the numbers of lice seen during visual inspection of the hens was much more rapid.

WEINTRAUB (J.) & THOMPSON (C. O. M.). **Comparison of ronnel, Dowco 109, and Dowco 105 for systemic control of cattle grubs in Alberta.**—*J. econ. Ent.* **54** no. 1 pp. 79–84, 2 graphs, 17 refs. Menasha, Wis., 1961.

The following is based on the authors' abstract. In tests in Alberta in 1957–58 on the effectiveness of Dowco 109 (O-methyl O-4-tert.-butyl-2-chlorophenyl methylphosphoramidothioate) and Dowco 105 (O-methyl O-4-tert.-butyl-2-chlorophenyl ethylphosphoramidothioate) as oral drenches, injections, sprays or feed additives [*cf. R.A.E.*, B **49** 153] against *Hypoderma* larvae in cattle, in which fenchlorphos (ronnel) administered in bolus form at the recommended rate of 110 mg. per kg. body weight was used as a standard of comparison, it was found that an emulsion of Dowco 109 injected subcutaneously at 15 mg. per kg. [*cf.* **48** 198] and wettable Dowco 105 administered as an oral drench [*cf.* **49** 123] at 25 mg. were more effective against migrating larvae of *H. lineatum* (Vill.) and *H. bovis* (Deg.) and encysted larvae of *H. lineatum*, respectively, than fenchlorphos. A solution of Dowco 109 and an emulsion of Dowco 105 injected subcutaneously at 5 and 25 mg. per kg., respectively, and 0·75 per cent. wettable Dowco 109 sprayed on to the upper parts of the bodies of cattle, were ineffective, but other treatments with Dowco 109 in the food [*cf.* **48** 97] or as intramuscular or subcutaneous injections or with either compound as an oral drench, were as effective as fenchlorphos. The lack of control in a few cattle that were treated with Dowco 109 as an injection or as a feed additive was attributed to an accumulation of toxic components that was slower than the degradation of the insecticide. The effective subcutaneous injection of Dowco 109 emulsion caused inflammation that disappeared in 4–14 days, but both the Dowco 109 solutions and the Dowco 105 emulsions resulted in severe and long-lasting sterile abscesses and fibrous lumps at the site of injection. In 1958, ataxia appeared in some of the cattle treated with fenchlorphos [*cf.* **48** 140, etc.] and in some injected with Dowco 109 at the rate of 15 mg., but the symptoms might have been due to the death and disintegration of the larvae.

WEINTRAUB (J.), MCGREGOR (W. S.) & BRUNDRETT (H. M.). **Artificial infestations of the northern cattle grub,** *Hypoderma bovis*, **in Texas.**—*J. econ. Ent.* **54** no. 1 pp. 84–87, 1 graph, 8 refs. Menasha, Wis., 1961.

The following is substantially the authors' abstract. In 1956–57, adults of *Hypoderma bovis* (Deg.) were reared in the laboratory in Texas from larvae that had dropped from cattle brought from South Dakota. The adults were induced to mate during tethered flight and the tethered fertilised females to oviposit by forcing them alternately to fly and settle on a calf; calves were infested with 50–1,000 eggs each in April and May. In outdoor mating trials, the behaviour of flies was similar to that observed in Canada, where *H. bovis* is indigenous, but temperatures above 85–90°F. curtailed mating and oviposition, which therefore could be induced only in the morning or evening. Survival of larvae to the encysted stage seemed to be inversely related to the number of eggs used, but an abnormally low percentage of larvae survived in calves infested with 1,000 eggs late in the season; this may have been due to the infertility of the eggs or to their mortality at the excessively high temperatures prevailing. It was concluded that climatic factors in Texas do not limit the normal survival of the larvae of *H. bovis*, though they reduce the reproductive activity of the adults and the viability of the eggs.

Parrish (D. W.). **The ticks (Argasidae and Ixodidae) of Turkey.**—*J. econ. Ent.* **54** no. 1 pp. 91–92, 1 map. Menasha, Wis., 1961.

A list is given of 19 species of ticks in eight genera collected in Turkey between April 1958 and June 1959. Species included, and (in brackets) the hosts on which they were found, were *Argas persicus* (Oken) (fowl), *A. reflexus* (F.) (man) [*cf. R.A.E.*, B **46** 87], *Ornithodoros lahorensis* Neum. (man, cattle, sheep and camel), *Ixodes ricinus* (L.) (cattle, water buffalo, sheep and dog), *Boophilus calcaratus* (Bir.) (cattle, horse, donkey, water buffalo and sheep), *B. annulatus* (Say) (cattle), *Dermacentor marginatus* (Sulz.) (cattle, sheep and goat), *Haemaphysalis otophila* Schulze (cattle, dog and cat), *Hyalomma detritum* Schulze (cattle, horse, donkey, sheep and goat), *Rhipicephalus bursa* (C. & F.) (cattle, horse, sheep, goat, camel and dog) and *R. sanguineus* (Latr.) (cattle, horse, water buffalo, sheep and dog) [*cf.* **43** 21]. *A. reflexus* and the three species that follow it were found also on vegetation. The six species that have been incriminated in the transmission of disease agents to animals in Turkey, and (in brackets) the agents transmitted, are *R. bursa* and *Haemaphysalis otophila* (*Piroplasma* (*Babesiella*) *ovis*), *B. calcaratus* (*P. bigeminum*), *Hyalomma detritum* (*Theileria annulata*), *A. persicus* (*Borrelia anserina* (*Spirochaeta gallinarum*)) and *O. lahorensis* (*Coxiella burneti*) [*cf.* **42** 96]. Four topographical areas are designated and illustrated on a map, the coastal plain, Anatolia, eastern Anatolia and south-eastern Anatolia, and those in which each species was found are shown.

Dorough (H. W.), Brady jr. (U. E.), Timmerman (J. A.) & Arthur (B. W.). **Residues in tissues and eggs of poultry receiving Co-Ral (Bayer 21/199) in the feed.**—*J. econ. Ent.* **54** no. 1 pp. 97–100, 1 graph, 11 refs. Menasha, Wis., 1961.

The following is substantially the authors' abstract. Laying hens were allowed to feed on mash containing coumaphos (Co-Ral) labelled with ^{32}P at a concentration of 100 parts per million for a maximum of seven days. They were slaughtered in groups of three at intervals after treatment, and the amounts of coumaphos remaining in the tissues and present in the eggs were determined [*cf. R.A.E.*, B **49** 250]. The liver and kidneys contained the highest concentrations of total radioactive material, and very little was found in the fat. Acetonitrile-soluble materials were found in their highest concentration in the liver, kidney and gizzard, but were not present in any of the tissues of hens that had been returned to normal feed for seven days; small but detectable amounts were present in egg yolks analysed 11–15 days after treatment of the hens, but none was present in the albumin. About 79 per cent. of the radioactive coumaphos consumed in the feed was excreted within 28 days of treatment; more than 85 per cent. of the excreted radioactive materials were hydrolytic products. Unchanged coumaphos, its oxygen analogue (O,O-diethyl O-3-chloro-4-methyl-7-coumarinyl phosphate), O-O-diethyl phosphoric acid and O,O-diethyl phosphorothioic acid were isolated from the droppings of treated hens.

Plapp jr. (F. W.) & Bigley (W. S.). **Inhibition of house fly ali-esterase and cholinesterase under *in vivo* conditions by parathion and malathion.**—*J. econ. Ent.* **54** no. 1 pp. 103–108, 3 graphs, 10 refs. Menasha, Wis., 1961.

Studies were made of the relative susceptibility of the aliesterase and cholinesterase activity of a susceptible strain of *Musca domestica* L. to *in* *vivo* inhibition by parathion and malathion, and of the comparative inhibition of these enzymes by parathion in flies of a susceptible and a parathion-resistant strain. The insecticides were applied topically in acetone to female house-flies, and the activity of the aliesterase was determined from body (thorax and abdomen) homogenates and that of the cholinesterase from head homogenates of flies killed at intervals after treatment. It was shown with the susceptible strain that the use of a substrate protection technique, in which the head and body homogenates were prepared with acetylcholine bromide and methyl-n-butyrate, respectively, as substrates, as well as with a phosphate buffer, resulted in lower estimates of aliesterase inhibition by parathion than when the homogenates were prepared with the buffer only and the substrates added afterwards, whereas the cholinesterase estimates were not affected. The substrate protection technique was used throughout the subsequent experiments, in one of which the rate of enzyme inhibition was found to be the same whether susceptible flies were treated topically with parathion or were exposed to deposits of malathion on the inner surfaces of glass jars.

The following paragraph is virtually the authors' summary of the results of the work. Aliesterase was more rapidly inhibited *in vivo* than cholinesterase by either parathion or malathion [*cf. R.A.E.*, B **49** 191, etc.]. When dosages were such that all or some of the insects survived treatment, the level of aliesterase activity returned to normal within 24 hours. The patterns of inhibition of this enzyme were similar with both insecticides and did not seem to be directly related to their toxic action. Cholinesterase activity was more slowly and less reversibly inhibited and the inhibition was closely related to the observed symptoms of poisoning. The patterns of inhibition of both enzymes were similar in both susceptible and resistant strains of flies.

The explanation presented by van Asperen & Oppenoorth for the observed connection between low levels of aliesterase and resistance to organophosphates [**49** 76] is noted, and an alternative explanation is suggested, whereby aliesterase serves as a temporary storage site for the insecticide, which is later released intact to act on the cholinesterase after detoxifying enzymes have been rendered ineffective.

WEINBURGH (H. B.), KILPATRICK (J. W.) & SCHOOF (H. F.). **Field studies on the control of resistant house flies.**—*J. econ. Ent.* **54** no. 1 pp. 114–116, 2 refs. Menasha, Wis., 1961.

Experiments in Georgia in 1959 on the effectiveness of several organophosphates for the control of resistant populations of *Musca domestica* L. on dairy and poultry farms showed that fenthion (Bayer 29493), Dimetilan (3-methyl-5-pyrazolyl dimethylcarbamate) and fenchlorphos (ronnel) were the most effective. In dairy barns treated with deposit sprays of fenthion at 50 mg. toxicant per sq. ft., excellent control, as indicated by grill indices [*cf. R.A.E.*, B **38** 158], was achieved immediately; in one treated with a suspension, control was excellent for 11 weeks after application, and in two treated with emulsions it was satisfactory or excellent for six weeks or, when sugar was added, for 22 weeks. In liquid baits, emulsions containing fenthion caused reductions in indices, but failed to give satisfactory control, except on one poultry farm where they contained sugar and were applied weekly to cotton pads, causing a reduction in fly populations for two weeks, followed by excellent control for five weeks. Fenthion and Dimetilan were not effective in dry baits.

When plastic bands impregnated with Dimetilan at 2 g. per m. [*cf.* **49**

185] were installed in one dairy barn at 30 linear ft. per 100 sq. ft. of floor, fly densities dropped to control levels immediately, and satisfactory to excellent control was maintained for 20 weeks; in another, where the bands were installed at 6·5 linear ft., satisfactory control was not obtained until the eighth week after installation, but was then maintained for the remaining 18 weeks of the fly season. Cotton cords 3/32 in. in diameter, impregnated with fenchlorphos and installed in dairy barns at 30 linear ft. per 100 sq. ft. of floor, gave satisfactory to excellent control for 18–22 weeks [*cf.* **48** 201], whereas similar cords 3/16 in. in diameter gave unsatisfactory control for 14 weeks, followed by excellent control for eight weeks.

Spielman (A.). **Susceptibility of an eye gnat,** *Hippelates pusio*, **to residual insecticides.**—*J. econ. Ent.* **54** no. 1 pp. 130–131, 4 refs. Menasha, Wis., 1961.

Tests were carried out in 1959 to determine the susceptibility of females of *Hippelates pusio* Lw. caught on horses in Cuba to DDT, malathion, dieldrin and γ BHC (lindane). Filter papers that had been dipped in acetone solutions of the insecticides at concentrations of 0·0001–10 per cent. or in acetone alone, and then allowed to dry, were placed for 15 minutes in vials each containing ten females. Mortality and knockdown were observed 0·25—24 hours after the beginning of exposure, and the concentrations that produced 50 per cent. knockdown and kill were calculated. The most effective compound was γ BHC, which was rapid in action at low concentrations and gave marked immediate knockdown. DDT failed to give significant knockdown within six hours of exposure to the highest concentration used, and the interval between knockdown and death was as long as 12 hours. Dieldrin was slow in action, but low concentrations gave a high rate of knockdown within one hour. Malathion was slower in action than dieldrin but far more rapid than DDT. Fairly high concentrations were required to produce 50 per cent. knockdown within one hour of exposure. With γ BHC, dieldrin and malathion, the interval between knockdown and kill was 2–3 hours.

Georghiou (G. P.), Metcalf (R. L.) & March (R. B.). **The development and characterization of resistance to carbamate insecticides in the house fly,** *Musca domestica*.—*J. econ. Ent.* **54** no. 1 pp. 132–140, 4 graphs, 25 refs. Menasha, Wis., 1961.

The following is based mainly on the authors' abstract of this paper, in which the term resistance is applied to increases of five or more times in the LD50 and tolerance to increases of lower magnitude. Two sub-colonies of a strain of *Musca domestica* L. of nearly normal susceptibility to all insecticides except cyclodienes were selected with Isolan and AC-5727 (m-isopropylphenyl methylcarbamate), respectively, both by incorporation into the rearing media and by topical treatment of the adults that emerged, the total selection pressure in each generation being adjusted to about 90–95 per cent. After selection for 20 generations, adults and larvae, respectively, showed resistances of seven and 19·5 times the normal to Isolan and more than 50 and 7·5 times the normal to AC-5727; when the latter was injected into adults, instead of being applied topically, resistance was 4·9 times the normal. Both selected strains showed almost complete cross-resistance to o-isopropylphenyl, m-isopropylphenyl, o-isopropoxyphenyl and m-tert.-butylphenyl methylcarbamates and also to Pyrolan and Sevin. Cross-resistance to 3,5-dimethoxyphenyl methylcarbamate was about ten and that to phenyl dimethylcarbamate about three times the normal. Both strains showed cross-tolerance of less than three times the normal to DDT, Prolan, parathion, Chlorthion and dicapthon and 3–6 times the normal to methoxy-DDT (methoxychlor), malathion, diazinon, fenchlorphos (ronnel) and allethrin. Strains of *M. domestica* resistant to chlorinated hydrocarbon and organophosphorus insecticides showed about the same level of cross-resistance to carbamate insecticides as the strains selected with carbamates. Unlike the carbamate-selected strains, however, organophosphorus-resistant strains showed high cross-resistance to DDT and related compounds. Cross-tolerance to Isolan and AC-5727 in 1:5 combinations with piperonyl butoxide was less than six and less than three times the normal, respectively, in all resistant strains, irrespective of the selecting agents. Selection, applied to the larvae only, of the strain resistant to AC-5727 for eight additional generations with a 1:5 combination of this and piperonyl butoxide resulted in only threefold tolerance to this combination.

GEORGHIOU (G. P.) & METCALF (R. L.). **Synergism of carbamate insecticides with octachlorodipropyl ether.**—*J. econ. Ent.* **54** no. 1 pp. 150–152, 1 graph, 8 refs. Menasha, Wis., 1961.

In tests in which octachlorodipropyl ether (bis(2,3,3,3-tetrachloropropyl) ether), which is known to synergise pyrethrum [*R.A.E.*, B **48** 133], was applied topically alone or in combination with m-isopropylphenyl methylcarbamate, 3,5-dimethoxyphenyl methylcarbamate, m-tert.-butylphenyl methylcarbamate, Isolan, Pyrolan or Sevin to females of a susceptible strain of *Musca domestica* L., and alone or in combination with the first three carbamates to females of a carbamate-resistant strain of the fly [*cf.* previous abstract], the ether was found to act as a synergist for the carbamates. With a 2 μg. dose of the first compound, a ratio of 1:20 of toxicant and synergist produced the effect on both strains of flies. As m-isopropylphenyl methylcarbamate was synergised even when the two compounds were applied separately to different parts of the integument, it was concluded that the synergistic effect of the ether is not primarily due to enhanced penetration of the carbamate. When m-isopropylphenyl methylcarbamate was applied to flies at various intervals after the application of the ether, it was found that the synergistic effect of the latter persisted for at least four days. The effect is believed to be due to inhibition by the ether of one or more of the enzymes that detoxify carbamates.

WEIDHAAS (D. E.), BOWMAN (M. C.) & SCHMIDT (C. H.). **Loss of parathion and DDT to soil from aqueous dispersions and vermiculite granules.**—*J. econ. Ent.* **54** no. 1 pp. 175–177, 14 refs. Menasha, Wis., 1961.

Effective control of mosquito larvae has been obtained with granular formulations of insecticides [*R.A.E.*, B **45** 196; **46** 6, etc.] and by introducing toxicants into irrigation water [**47** 206, etc.], which laboratory experiments have shown to be less effective in the presence of soil [**49** 136]. Studies were therefore made of the fate of parathion labelled with ^{32}P and DDT labelled with ^{14}C in water dispersions over soil when applied in different formulations, and of the rate of release of these insecticides from vermiculite granules. The following is largely based on the authors' summary of the results. Both compounds were strongly adsorbed by soil from water dispersions. After 24 hours, the percentage loss of DDT from two different volumes of water was the same (about 78), but that of parathion from the larger volume was about half (38) that from the smaller. Exposure of fourth-instar larvae of *Anopheles quadrimaculatus* Say to extracts from the parathion-treated water and soil after 24 hours showed no appreciable loss in toxicity, so that any derivatives formed were equal in toxicity to parathion. Tests with suspensions of 0·01 part DDT per million in brackish marsh water showed that large variations in pH values, total solids and chloride content had little effect on the distribution of DDT [*cf.* **44** 131] or on its loss by codistillation [*cf.* **49** 83, etc.]. Parathion was readily released into water from vermiculite; decreasing the concentration of parathion on the granules or increasing the depth and volume of the water increased the percentage released at a given time. When granules of DDT on vermiculite were placed in water, less than 20 per cent. of the insecticide was dispersed after two and 24 hours, indicating that release occurred at the time of application.

Hoy (W.) & Gordon (H. T.). **Metabolism of injected proline in DDT-poisoned German cockroaches.**—*J. econ. Ent.* **54** no. 1 pp. 198–199, 2 refs. Menasha, Wis., 1961.

Poisoning with DDT has been reported to cause a decrease in the concentration of proline in the haemolymph of *Periplaneta americana* (L.), and experiments were therefore undertaken with males of *Blattella germanica* (L.) to determine the effect of DDT on their content of this amino acid and the rate at which it disappears when injected into normal and DDT-poisoned cockroaches. Analysis of extracts from two macerated males 12 hours after topical application of 20 μg. DDT showed their total proline content to be 6 and 7 μg., respectively, as compared with 22 and 27 μg. in two untreated cockroaches. As most of the free proline is in the body tissues, these results indicate that tissue proline, like haemolymph proline, is greatly decreased by DDT poisoning. Analyses of pairs of cockroaches that had been injected with 400 μg. l-proline and received a topical application of 20 μg. DDT immediately afterwards, and of pairs that had received the proline injections only, at various intervals after treatment, showed that proline disappeared more rapidly from those that had been treated with DDT than from those that had not. Chromatographic studies of antennal haemolymph showed that the rate of disappearance of proline from the haemolymph corresponded to its rate of disappearance from the whole body, indicating that there is a rapid exchange of proline between haemolymph and body tissues. It is suggested that the disappearance of proline is due to its metabolism in the tissues, and that the muscular hyperactivity of DDT-poisoned cockroaches stimulates this metabolic reaction. The presence of abnormally large amounts of proline in the bodies of cockroaches did not seem to lessen the symptoms of DDT poisoning.

Yeomans (A. H.), Fulton (R. A.) & Sullivan (W. N.). **Aerosol dispensing system for aircraft disinsectization.**—*J. econ. Ent.* **54** no. 1 pp. 199–200, 2 figs., 3 refs. Menasha, Wis., 1961.

To prevent the introduction of insect pests into the United States, aircraft entering the country have for many years been treated with insecticide aerosols, and a method has been developed by which small single-spray aerosol containers placed at several points throughout the aircraft are discharged simultaneously. Aluminium containers of 10 or 30 cc. capacity, filled with enough insecticide and propellent to treat 1,000 cu. ft. of space, are locked into position and their valves are broken off by a spring mechanism that is released by electrical or mechanical means. In an aircraft fuselage of 2,000 cu. ft. capacity, complete control of caged and free adults of *Aëdes aegypti* (L.) was obtained when two aerosol containers each containing 10 g. of a mixture of allethrin and dichlorodifluoromethane (as the propellent) were discharged, giving a rate of 100 mg. allethrin per 1,000 cu. ft.

Roth (A. R.) & Eddy (G. W.). **Field tests with new cattle grub systemics.** —*J. econ. Ent.* **54** no. 1 pp. 203–204, 4 refs. Menasha, Wis., 1961.

In preliminary field tests in Oregon in 1959 on the effectiveness of Ruelene (O-methyl O-4-tert.-butyl-2-chlorophenyl methylphosphoramidate), fenthion (Bayer 29493), Bayer 22408 (O,O-diethyl O-naphthalimido phosphorothioate) and coumaphos (Co-Ral) against *Hypoderma* in cattle, the compounds were applied as sprays in October and November, several weeks before the larvae reach the backs, at a rate of 1 U.S. gal. per animal. Untreated controls were not separated from treated cattle. Examination of cattle early in the following year showed that all larvae present in January and most of those found in February were of *H. lineatum* (Vill.), whereas all those removed in April were of *H. bovis* (Deg.). The tests with one herd showed that control was complete for 0·25 per cent. fenthion, 98–100 per cent. for 0·75 per cent. Ruelene [*cf. R.A.E.*, B **49** 182], 75–86 per cent. for 0·5 per cent. coumaphos and 0–40 per cent. for 0·75 per cent. Bayer 22408. The results of further tests in which three herds were sprayed with various concentrations of Ruelene indicated that a concentration of at least 0·5 per cent. is required for control to be consistently satisfactory.

Magy (H. I.) & Lee (A. A.). **Occurrence of *Hippelates* eye gnats in a coastal habitat in California.**—*J. econ. Ent.* **54** no. 1 pp. 206–207, 2 refs. Menasha, Wis., 1961.

Species of *Hippelates*, certain of which are believed to be associated with epidemics of conjunctivitis in the Coachella Valley of California [*cf. R.A.E.*, B **41** 87, 88], are significant pests in many of the cultivated desert areas in the south of the State. In a hilly, coastal area in south-western California, where the climate is mild, weekly collections were made in 1957–58 by means of traps baited with rotten eggs, and three species, *H. collusor* (Tns.), *H. robertsoni* Sabrosky and *H. pusio* Lw., were taken. *H. robertsoni* predominated in winter and *H. collusor* in summer, and *H. pusio* was taken only in small numbers in a few traps in January–February. Adults were present throughout the year, with the greatest numbers occurring in summer; high numbers in late spring and early summer seemed to be associated with soil cultivation, large-scale emergence occurring a few weeks after it. Numbers were variable at all seasons.

Simco (J. S.) & Lancaster jr. (J. L.). **Control of cattle grubs and horn flies by summer dipping with Co-Ral.**—*J. econ. Ent.* **54** no. 1 pp. 208–209, 4 refs. Menasha, Wis., 1961.

Tests carried out in Arkansas in 1959–60 in which cattle infested by *Siphona irritans* (L.) and larvae of *Hypoderma lineatum* (Vill.) were dipped in 0·24 per cent. wettable coumaphos (Co-Ral) in summer resulted in excellent to moderate control of the former for up to three weeks after dipping, and excellent and very good control of the latter in animals dipped three times and twice, respectively. Analyses of coumaphos in the dip indicated an almost linear relation between the removal of the insecticide and the water; the concentration tended to rise with the evaporation of water and to fall with the addition of rain. The movement of cattle through the vat containing the dip caused better agitation of the material than was obtained by means of a bucket.

MATHIS (W.), KILPATRICK (J. W.) & JOHNSON (H. F.). **DDT resistance in** *A. quadrimaculatus*.—*Publ. Hlth Rep.* **75** no. 5 pp. 387–390, 4 refs. Washington, D.C., 1960.

Anopheles quadrimaculatus Say is known to have developed resistance to dieldrin in Mississippi, whereas susceptibility to DDT has remained unimpaired [*cf. R.A.E.*, B **46** 182–183]. However, at Clark Hill Reservoir, Georgia, where DDT was used every year from 1952 to 1959 against the larvae at rates of 0·08–0·2 lb. per acre in quantities varying from 4,276 to 10,788 lb. per annum, the number of adults per inspection at various stations rose from under four in 1954–58 to 15·85 in 1959. At the station with the highest catches (a stable), the number per inspection rose from 40·28 in 1958 to about 200 in 1959, in spite of 18 weekly applications of larvicide during the season. In tests for resistance to DDT, larval progeny of wild-caught females showed 8 and 49 per cent. mortality when exposed for 24 hours to 0·02 and 2·5 parts DDT per million, respectively, whereas larvae of a susceptible strain showed complete mortality in both cases. Corresponding figures for dieldrin were 29 and 100 for Clark Hill larvae and again complete mortality for the susceptible strain. One-hour exposure to papers treated with 4 per cent. DDT and 1·6 per cent. dieldrin gave 4 and 38 per cent. kill, respectively, corresponding mortalities for adults of the susceptible strain being 100 and 97 per cent. Exposure for 4 hours to paper treated with 4 per cent. DDT gave only 18 per cent. mortality of adults collected and tested in the field on 22nd September. These data showed that *A. quadrimaculatus* from Clark Hill Reservoir was resistant to DDT in both the adult and larval stages, but, owing to the lack of pre-treatment data, it is not certainly known whether this was a result of selection.

PAPERS NOTICED BY TITLE ONLY.

GRADIDGE (J. M. G.). **A comparison of mortality and paralysis in the assay of pyrethrum preparations.**—*Sci. J. R. Coll. Sci.* **27** pp. 10–12, 7 refs. London, 1959. [See *R.A.E.*, A **49** 609.]

SYRJÄMÄKI (J.). **Preliminary observations on the daily rhythm of biting activity of some** *Aëdes* **species** [mainly *A. communis* (Deg.) and *A. cantans* (Mg.), in Finland] **(Dipt., Culicidae).**—*Ann. ent. fenn.* **26** no. 1 pp. 92–97, 2 graphs, 7 refs. Helsinki, 1960.

DOSS (M. A.), HUMPHREY (J. M.) & SEGAL (D. B.). **Index-catalogue of medical and veterinary zoology. Supplement 11. Authors: A to Z.**—[1 +] 409 pp. Washington, D.C., U.S. Dep. Agric., 1961. Price $1.50 (from Supt. Documents). [*Cf. R.A.E.*, B **49** 92.]

SAYIN (F.). **Ankara ve civarı sığırlarında bulunan Anoplura ve Mallophaga'lar üzerinde sistematik araştırmalar.** [Systematic investigations on the Anoplura and Mallophaga of cattle in Ankara and district.]—*Yayın. Ankara Üniv. vet. Fak.* [no.] 118 (Çalışm. [no.] 63) [3 +] 112 pp., 46 figs., 96 refs. Ankara, 1960. (With a summary in English.)

The following is taken from the English summary. A taxonomic survey of cattle lice in Ankara province was made in 1956–57. Of 1,022 cattle examined, 402 were infested, the commonest species found being *Damalinia bovis* (L.), *Linognathus vituli* (L.), *Solenopotes capillatus* End., *Haematopinus eurysternus* (Nitzsch), *H. tuberculatus* (Burm.) and *Menacanthus* (*Eomenacanthus*) *stramineus* (Nitzsch). Numbers increased in autumn and reached a maximum in winter and early spring. The first three species were commoner on young than on mature animals. Lice were found to be the commonest parasites of cattle in the area surveyed.

WILSON-JONES (K.) & DAVIDSON (G.). **Dosage-mortality curves for houseflies susceptible and resistant to DDT.**—*Nature* **182** no. 4632 pp. 403–404, 2 graphs, 2 refs. London, 1958.

P. S. Hewlett recently directed attention to the fact that the slopes of lines relating probit-mortality to the log.-dose of DDT are less steep for resistant than for susceptible strains of house-flies [*Musca domestica* L.] and put forward two possible explanations [*R.A.E.*, B **47** 60]. The present authors advance the alternative explanation that DDT-resistance in house-flies is genetically controlled and that very few of the strains of insects so far examined represent genetically pure lines. The effect of this is illustrated in the case of resistance governed by a single incompletely dominant gene (R) and in that of polygenic resistance, due to a number of weak genes acting together. Most cases of resistance in house-flies are believed to be of the latter type. In the first case, unless a pure line of resistant (RR) constitution can be isolated from its allelomorphs, a dosage-mortality test of flies of a given generation will show a response of individuals ranging from complete susceptibility to the highest resistance expressible by the gene in question. As resistant genes are extremely rare in nature [*cf.* **47** 72], the control will represent a purer line of susceptibility than the resistant does of resistance, and the difference in the slopes principally represents the difference between the pure and impure samples. The case of polygenic resistance is similar but more complex, and separation of the genotypes becomes virtually impossible.

If a strain were pure, the slope would depend only on error in sampling and testing methods and a certain variation between individual flies. In the case of a mixed strain, the difference between the LD 0 and LD 100 is increased by the extent to which the component genotypes differ one from another. However, testing a greater number of intermediate dosages may lead to the resolution of the gently sloping curve of a resistant population into several parallel ones equal to the number of genotypes present. This is illustrated by means of graphs for the Western Sokoto strain of *Anopheles gambiae* Giles resistant to BHC and dieldrin [**48** 233]. In the case of BHC, for which resistance is only about 30-fold, a tripartite segregation of the graph is indicated, but not obvious because the gaps between the LD 100 of the susceptibles and the LD 0 of the hybrids and the LD 100 of the hybrids and the LD 0 of the resistants are very small. Resistance to dieldrin is about 800-fold, and the regression line for the theoretical offspring of the back-cross of hybrids with the susceptible parent, based on mortalities recorded among susceptible and hybrid strains, shows a definite step in the line separating the susceptible and the hybrid parts of the population, where an increase in dosage produces no increase in kill.

In a note appended to the paper, Hewlett points out that DMC synergises the action of DDT applied to resistant flies by depressing its enzymatic detoxification [*cf.* **43** 28; **44** 100] and at the same time increases the slope of the regression line. This strongly suggests that the detoxification mechanism is directly concerned in depressing the slope of the line for DDT without synergist, as discussed in his original paper.

LAURENCE (B. R.). **Oviposition by *Mansonioides* mosquitoes in the Gambia, West Africa.**—*Proc. R. ent. Soc. Lond.* (A) **34** pt. 10–12 pp. 161–170, 4 figs., 22 refs. London, 1959.

The following is based on the author's summary of the results of observations on the plants used for oviposition by species of *Mansonia* (*Mansonioides*) in the Gambia. In the absence of *Pistia*, *M. africana* Theo. and *M. uniformis* (Theo.) oviposited on the lower surfaces of floating leaves of several plants, of which *Nymphaea micrantha* was the commonest, the females selecting breeding places containing emergent vegetation, including grasses, on the roots of which the larvae and pupae are found. They were attracted more by the position of a floating leaf in relation to the surrounding vegetation than by its shape, size or species. Egg-masses were not found on leaves floating in open water, nor on those that were not floating within 15 cm. of standing emergent vegetation. They were rarely found on leaves more than 12 cm. wide, and those that were found on leaves 16 cm. or more wide were laid through fenestrations in the leaf; this suggested that the female may fly away without ovipositing if, after a normal period of search, the edge of the leaf is not reached. In one small area, the rate of oviposition did not vary much over a period of 14 days, and there was no evidence of sudden mass oviposition. Similar numbers of egg-masses were laid on floating leaves in unweeded rice-fields and on leaves floating among the emergent vegetation of small pools. The clearance of rice swamps by normal weeding and planting reduced the breeding area of *Mansonia*, whereas unweeded rice-fields were foci for breeding.

MURPHY (D. H.) & GISIN (H.). **The preservation and microscopic preparation of Anopheline eggs in a lacto-glycerol medium.**—*Proc. R. ent. Soc. Lond.* (A) **34** pt. 10–12 pp. 171–174, 14 refs. London, 1959.

Anopheline eggs were preserved by squeezing them from fully gravid females on to a drop of a preserving medium consisting of lactic acid (1 part), glycerol (8 parts) and a saturated solution of picric acid in glycerol (1 part). Eggs were preserved in this for over a year without visible deterioration. It was subsequently found preferable to reduce the intensity of the stain by using half the quantity of picric acid and making up the deficit with glycerol. A method of making permanent mounts is described.

SERVICE (M. W.). **A taxonomic study of *Anopheles funestus funestus* Giles (Diptera Culicidae) from southern and northern Nigeria, with notes on its varieties and synonyms.**—*Proc. R. ent. Soc. Lond.* (B) **29** pt. 5–6 pp. 77–84, 8 figs., 18 refs. London, 1960.

Anopheles funestus funestus Giles disappeared after BHC had been used for a few months in a malaria-control project at Ilaro, in a zone of dense secondary forest in southern Nigeria, but was not eliminated after three years of continuous spraying with BHC, DDT and dieldrin in western Sokoto, Northern Nigeria. The possible existence of two taxonomic or physiological populations was therefore investigated. A detailed taxonomic study of the species in Nigeria was made, in which northern and southern populations were compared, and the findings are recorded in detail. The general morphology of the eggs was in good agreement with the descriptions given by previous authors, with minor differences. The larvae of both populations were typical, and there was no clear distinction between the proportion of larvae in wild and colonised populations having the accessory tergal plates on the abdomen free [*cf. R.A.E.*, B **25** 182]. The chaetotaxy of the pupal plates and general pupal characters did not differ appreciably in the two populations. The adults were typical; the pharyngeal armature and genitalia were identical in both populations, and no statistically significant differences were found except in the scaling of the wings. It is concluded that the populations are morphologically indistinguishable, but that, although there are no precise figures to support the theory of the existence of strains of different susceptibility, this, or the existence of a cryptic species, remains possible. The synonyms of *A. funestus* are reviewed.

SHAH (K. V.), JOHNSON (H. N.), RAO (T. R.), RAJAGOPALAN (P. K.) & LAMBA (B. S.). **Isolation of five strains of Sindbis virus in India.**—*Indian J. med. Res.* **48** no. 3 pp. 300–308, 7 refs. New Delhi, 1960.

Sindbis virus was first isolated from Culicine mosquitos collected in the region of Sindbis village in Egypt in 1952 [*R.A.E.*, B **43** 129; **45** 101] and was also isolated from Culicines collected near Johannesburg, South Africa, in 1954. In the present paper, the isolation is recorded of a strain of the same virus from migratory wagtails (*Motacilla alba*) collected in Poona district, Bombay State, two strains from hill mynas (*Gracula religiosa*) collected in Kerala State and one strain each from a pool of mites (*Ornithonyssus* (*Bdellonyssus*) *bursa* (Berl.)) taken from domestic fowls and a mixed pool of five species of *Culex* from North Kanara District, Mysore State, all in 1953. The infection in the mites was apparently in ingested blood and represented a chance feeding on an infected fowl. The immunity rates found in man were low. The virus belongs to the A group of arthropod-borne viruses [**49** 203], and this is the first recorded evidence of the presence of a member of this group in India.

DAVID (H. V.). **A simple method for breeding the eye fly—*Siphunculina funicola* (Diptera, Oscinidae) in the laboratory and some observations on its life cycle.**—*Indian J. med. Res.* **48** no. 3 pp. 326–330, 8 refs. New Delhi, 1960.

Many different forms of decomposing vegetable and animal matter were tried as breeding media for *Siphunculina funicula* (de Meij.) at Colombo. It was found that the eggs were destroyed by fungi unless the media were mixed with sterilised sand, and the best results were obtained when the mixture was itself sterilised by autoclaving. In the trials with the sand mixtures, the greatest number of eggs was laid in decomposing fish, and large numbers also in beef, human faeces and coconut refuse (left from the raw kernel after the milk had been squeezed out). There was generally very little oviposition in vegetable media. A sterilised mixture of decomposing fish and sand was used successfully to maintain a colony. The life-cycle took an average of 22 days at about 80–89°F. and 73–80 per cent. relative humidity.

ELLIOTT (R.). **Insecticide resistance in some *Anopheles* larvae.**—*Indian J. Malar.* **13** no. 1 pp. 7–11, 2 graphs, 5 refs. Delhi, 1959.

The following is based on the author's summary. The method of Elliott [*R.A.E.*, B **49** 16] was used to determine the susceptibility of larvae of two strains of *Anopheles sundaicus* (Rdnw.) and of three strains of *A. stephensi* List. to DDT, dieldrin or both. Comparison of the LC50's of insecticides for adults and the corresponding larvae of susceptible and resistant strains of these two species and of *A. gambiae* Giles [**45** 68; **49** 16] showed that there is a relation between the degree of susceptibility shown by the larvae and that of the corresponding adults. A formula expressing this relation, by which the susceptibility of adults to an insecticide can be calculated from observations on the larvae, is proposed.

SEN (P.). **Studies on insecticide resistance in insects of public health importance in West Bengal, India.**—*Indian J. Malar.* **13** no. 1 pp. 19–33, 32 refs. Delhi, 1959.

Investigations on insecticide resistance in insects of medical importance in West Bengal in 1956–58, in which susceptibility of adults of local strains to insecticides was determined by the technique of Busvine & Nash [*R.A.E.*, B **41** 156], showed that *Musca domestica vicina* Macq., *Culex pipiens fatigans* Wied. and *Cimex hemipterus* (F.) [*cf.* **48** 172] are resistant to DDT. DDT has not been applied for the control of adult insects in this area, and sprays of DDT or BHC have been applied only very occasionally against *Culex* larvae. Various species of *Anopheles*, *Aëdes aegypti* (L.) and *Xenopsylla cheopis* (Roths.) were susceptible to both organophosphorus and chlorinated-hydrocarbon insecticides, and a laboratory strain of *Phlebotomus argentipes* Ann. & Brunn. was highly susceptible to DDT and BHC.

NAIR (C. P.), KRISHNAN (K. S.) & ROY (R. G.). **Filariasis in Kerala State. Part V. Filaria survey of Edapally Panchayat (Ernakulam District).** —*Indian J. Malar.* **13** no. 2–3 pp. 117–123, 1 map, 2 refs. Delhi, 1959.

The following is based on the authors' summary. A filariasis survey was carried out in Edapally Panchayat, a rural area in Kerala State, in January–February 1957 [*cf. R.A.E.*, B **49** 202]. Filarial infection was almost exclusively with *Brugia* (*Wuchereria*) *malayi*, and *Mansonia* (*Mansonioides*) *annulifera* (Theo.) was the only vector.

KRISHNASWAMI (A. K.), PATTANAYAK (S.) & RAGHAVAN (N. G. S.). **The susceptibility of *Culex fatigans* to different densities of *Mf. bancrofti*.**—*Indian J. Malar.* **13** no. 4 pp. 153–157, 1 graph, 11 refs. Delhi, 1959.

The following is substantially the authors' summary. Studies were made in Kerala State of the effect on the development of microfilariae of a periodic (nocturnal) strain of *Wuchereria bancrofti* in females of *Culex pipiens fatigans* Wied. of feeding the mosquitos on infected volunteers with different densities of microfilariae in their blood. The percentage of mosquitos infected and the number of infective larvae per infected mosquito increased with densities of up to 100 microfilariae per 20 cu. mm. of blood, but with higher densities the number of infective larvae in the mosquitos decreased steadily. Mosquitos became infected even after feeding on volunteers showing no microfilariae in the peripheral blood at the time.

Ranade (D. R.). **Some observations on the range of flight of the common Indian housefly,** *Musca domestica nebulo*, **Fabr.**—*J. Anim. Morph. Physiol.* **3** no. 2 pp. 104–108, 8 refs. Bombay, 1956.

In experiments on the range of flight of *Musca domestica nebulo* F. in Poona in June and July 1955, flies were dusted with red chalk and released 1,000 at a time from a building in a densely populated, congested part of the city, or from an open plot in a sparsely populated, cleaner part; 59 of those released in the first site were collected 150–350 yd. from the point of release, many in a market about 300 yd. away, and 43 of those released in the second were recovered 400–600 yd. away, some from neighbouring houses and some from tea-shops at a distance of about 600 yd. It is presumed that the flies gathered at the nearest available source of food.

Alwar (V. S.), Lalitha (C. M.) & Achuthan (H. N.). **Depluming itch in fowls caused by the feather mite**—*Megninia ginglymura* (**Megnin**)—**a preliminary note.**—*Indian vet. J.* **35** no. 12 pp. 621–623, 1 pl., 5 refs. Madras, 1958.

In late February 1958, many of the fowls in a demonstration unit of the Madras Veterinary College began to lose their plumage and to exhibit other symptoms of ‘ depluming itch ’; on examination they were found to be infested by *Megninia ginglymura* (Mégn.) [*cf. R.A.E.*, B **28** 172]. Fowls with extensive skin lesions were dipped in a 0·05 per cent. aqueous suspension of dieldrin, and, after about ten days, feathers began to appear on the bare areas, no living mites were present, and the eggs of the mite became transparent. Fowls were dipped again on the 15th day, and, after about a month, all bare patches were completely covered with feathers. Similar treatment of the rest of the birds gave equally successful results.

Barker (T. W.). **An enquiry into the control of pests of racing pigeons.**—*Pest Technol.* **2** no. 10 pp. 203–208, 9 refs. London, 1960.

The author reviews features of the maintenance and transport of racing pigeons in Britain that favour their infestation by Mallophaga, ticks and mites, and considers the measures available for the control of these pests, including spraying of pigeon-lofts with residual insecticides and individual treatment of the birds with hand-sprayers. In tests of suitable sprays for treatment of birds, litter and travelling baskets, a synergised pyrethrum preparation used at a strength of 1 per cent. pyrethrins and a mixture containing equal amounts of malathion and an acaricidal ester of benzyl alcohol used at 1 and 4 per cent. of malathion were found harmless to the birds.

Stampa (S.). **Tick paralysis in the Karoo areas of South Africa.**—*Onderstepoort J. vet. Res.* **28** no. 2 pp. 169–227, 15 figs., 1 col. fldg. map, 59 refs. Pretoria, 1959.

Four different forms of tick paralysis can be distinguished in South Africa according to the symptoms and the species of tick involved. The most important economically is Karoo tick paralysis, which affects sheep, goats and cattle, some species of antelope and, exceptionally, dogs. It is caused by the bite of adult females of *Ixodes rubicundus* Neum., which are active during the winter. Immature stages only exceptionally attach themselves to the susceptible hosts. All early references to tick paralysis in South African literature, some of which are reviewed in the present paper, refer to this type, and it was shown in 1950 that although some paralysis had previously been attributed to *I. pilosus* Koch [*cf. R.A.E.*, B **32** 18, etc.], *I. rubicundus* alone is found in the areas from which the paralysis has been recorded [**40** 171]. The range of the tick has recently extended considerably into the Karoo, and the condition that it causes is spreading rapidly. Symptoms appear during the last phase of engorgement, and all limbs of the host are affected simultaneously. The rate of recovery is high if the ticks are removed but, if they are not, losses may be considerable. An unexpectedly early outbreak in 1951 resulted in mortality of up to 15 per cent. of the stock on some farms. *Rhipicephalus evertsi* Neum. causes spring lamb paralysis, and sporadic cases have been recorded in adult sheep and calves; it is present in most of South Africa throughout the year [**40** 171] and infests various other hosts, in none of which has paralysis been recorded. Outbreaks have occurred in the high veldt of the eastern Orange Free State, southwards to Sterkstroom in Cape Province and in the Belfast area of the Transvaal. Symptoms occur during engorgement. The hind legs only are affected, at least at first, regardless of the site of attachment. Recovery rate is high provided that the ticks are removed. Leg weakness in geese and ducks is caused in several parts of South Africa by *Argas persicus* (Oken). The condition has also been observed in fowls when larvae and adults engorge simultaneously, but adults can cause paralysis in geese and ducks in the absence of larvae. Symptoms appear 6½–7 days after engorgement, and only the legs are affected. The recovery rate is low. Paralysis, consisting of general weakness with undisturbed sensitivity and due to *R. simus* Koch, was recorded in a human adult in 1950. Chronic localised motor paralysis and complete loss of sensation in the affected area have been described in an adult, due to *Hyalomma truncatum* Koch, and reference made to their occurrence in a child, due to *I. rubicundus*.

In view of the spread of Karoo tick paralysis, intensive investigations on the habits and ecology of *I. rubicundus* and the conditions under which the affection occurs were begun in 1954 in the areas around New Bethesda, Cape Province, where the tick is particularly abundant and losses of sheep in recent years have been severe. Observations over three seasons showed that, under conditions of continuous grazing, adult females were present from February to October and most abundant in April and May. Larvae were found by dragging from March to August and were most numerous in May and June. Nymphs were taken on red hare (*Pronolagus rupestris saundersiae*) from May to January with a peak in August and September. Observations from 8 a.m. to 10 p.m. showed the adults to be active throughout this period but most so between 10 a.m. and 2 p.m.; the immature stages were found only at night. Larvae were active at temperatures as low as 3·1°C. [37·58°F.], and peak activity occurred between 12 and 13°C. [53·6 and 55·4°F.]. The chief hosts of the immature stages are *P. r. saundersiae*, *Lepus saxatilis albaniensis* and *Elephantulus* spp. Adults occur mainly on domestic stock, sometimes on antelopes and incidentally on other animals, but never on birds. The females attach themselves to the underside and legs of sheep, preferring the wooled parts of the body, on which higher proportions reach full engorgement. Engorgement usually took 4–7 days. It was most rapid at low temperatures and when the sheep was paralysed, and was more rapid on bare than wooled parts of the body of ewes. Two stages of engorgement were recognised, separated by a period of about two days during which the tick remains unchanged. Mating was observed to continue for periods of 1–9 days during attachment of the female and also to take place on the ground before attachment. Engorgement tended to be quicker when pairing began during the first three days of attachment. Observations on tick populations were made on tethered sheep and by a modification of the drag method in which small strips of material, often tubes of flannelette, rough side out, were fastened so as to trail behind a 6-ft. horizontal bar. Flannelette was the most attractive, to the immature stages, of various materials tested. Adults were strongly attracted to corduroy, but the immature stages were not. Strips of sheepskin with the wool attached and weighted so as to keep well down in the vegetation picked up the adults, which live at lower levels than the immature stages. Larvae were found to be very evenly distributed in the field.

A survey of the distribution of *I. rubicundus* in relation to the different types of veldt over a limited area in the Sneeuberg range showed that the presence of the tick could be correlated with certain plant associations. It did not occur in unmixed sweet-grass mountain veldt, which constitutes the original coverage of all mountains in the area, and showed an association with deterioration of pasture resembling that noted in the case of *I. ricinus* (L.) in Britain [**32** 232; **37** 193; **39** 46]. Tick paralysis was found in all poor veldt types providing little palatable food and in good pasture from which poor land had to be crossed to reach water. The tick was most susceptible to unsuitable environmental conditions in the larval stage, and eggs failed to hatch if grass was too short to offer good shelter or if moisture was deficient; all stages were killed by direct sunlight. Larval surveys in localities exposed to natural infestation showed that sweet-grass mountain veldt can support the tick if it is invaded by *Rhus erosa*. Tick densities were always significantly higher in veldt types with *R. erosa* than in the corresponding type without it. Existing plant associations can be altered, and in certain cases this can be done within a few years, but *R. erosa* does not disappear during reclamation by good grass management, although it can be controlled with weed-killers. Veldt fires can cause much improvement if correctly managed but cause considerable deterioration if the burnt veldt is restocked too soon.

Regular dipping reduces numbers of *I. rubicundus*, but there are no records of eradication of the tick by this means. Exclusion of sheep from infested areas during the season of tick activity has no effect on incidence. Dips containing several toxicants were compared in the laboratory by shaking ten ticks for one minute in a 1 × 1½ in. specimen tube with about 2–5 cc. wash, transferring them to filter paper in a petri dish and observing their condition after 24 and 48 hours. The results for each batch were recorded as a figure obtained by adding together the number affected but capable of slight movement, the number incapable of forward movement but alive multiplied by 3, and the number dead multiplied by 5, omitting the number not affected. It appeared that γ BHC was at least four times as toxic as dieldrin. The ability of a toxicant to diffuse along the wool fibres appeared to be important for protection against *I. rubicundus*, as it is against blowfly strike [**44** 89]. BHC protected sheep carrying six months' wool for more than 18 weeks when 4·75 g. γ isomer was deposited per sheep from a walk-through bath 18 in. deep, and dieldrin for about 11 weeks with a deposit of 7 g. active ingredient. It is estimated from the curves of protection that 1·65 g. γ BHC is equal in effectiveness to 7 g. dieldrin. This confirms the laboratory estimate. If immediate kill is important, the bath should be filled to a depth of 22 in. Immersion of the heads is essential. A field experiment with BHC against *Hyalomma* spp. and *Rhipicephalus evertsi*, which attach themselves to the bare parts of the sheep possibly without crawling through the wool, showed that high but not complete protection was achieved. No decrease in effectiveness was seen in four weeks. An emulsion with a high depletion rate gave a greater BHC deposit, and so better protection, than one with a lower rate.

For the control of *I. rubicundus* and prevention of tick paralysis, improvement of pasture quality, aimed at complete reclamation to sweet-grass veldt, combined with foot-dipping with γ BHC or dieldrin, is recommended.

STONE (B. F.). **The DDT-susceptibility of fourteen strains of the cattle tick, *Boophilus microplus* from northern New South Wales.**—*Aust. vet. J.* **36** no. 8 pp. 343–347, 4 refs. Sydney, 1960.

As a campaign to eradicate *Boophilus microplus* (Can.) from parts of northern New South Wales, by fortnightly dipping of cattle, sheep, horses and goats in suspensions of 0·5 per cent. p,p′DDT from January 1956 to March 1957, was unsuccessful, reinfestation beginning three months after treatment had ceased, 14 strains of the tick from two of the eradication areas were tested for resistance to DDT, in comparison with a DDT-susceptible one. No evidence of significant resistance was found in the experiments, the results of which are given in detail. It therefore seems safe to assume that DDT-resistance was not the primary reason for the failure of the campaign and, although suspensions prepared from the concentrate used in the eradication programme and four out of five samples of dipping fluid from vats charged with the preparation in the eradication areas proved at least as toxic as fluids prepared from a reference sample of the same concentrate, further investigations of the toxicity of the dipping fluids are desirable.

O'GOWER (A. K.). **Townsville Culicines as possible vectors of dengue and allied viruses among local feral fauna.**— *Aust. J. exp. Biol. med. Sci.* **38** no. 1 pp. 1–9, 22 refs. Adelaide, 1960.

An epidemic of dengue-like fever occurred in Townsville, northern Queensland, early in 1954, and investigations were carried out late in that year and in 1955 to determine the mosquitos involved in the transmission of the virus to man from the presumed reservoir of flying foxes (*Pteropus gouldi*) and migratory shore birds. Mosquitos were collected in or near areas frequented by the suspected animal reservoirs, in light-traps, from resting sites, or by aspiration from baits of man, horse or *Pteropus*, and the hosts upon which engorged females had fed were determined by precipitin tests against a wide range of antisera. Of 2,020 females collected, 713 were engorged with blood, the sources of which were determined in 549 and found to be man, horse, ox, dog or fowl; although none of the 20 species concerned had fed on *Pteropus*, 12 had fed on fowl and eight on man. *Mansonia* (*Taeniorhynchus*) *uniformis* (Theo.), *Aëdes vigilax* (Skuse), *Culex annulirostris* Skuse, *C. sitiens* Wied. and *C. pipiens fatigans* Wied. are thought to be the vectors of the virus, as they had all fed on fowl, the first four had fed on man, and *C. p. fatigans* is known to feed on man. Of these mosquitos, *A. vigilax* and *C. sitiens* are the main suspects; they had both fed on man and fowl, they were taken in mangrove swamps, in which *Pteropus* rests during the day and in which migratory birds roost at night, and they were the only species attracted to *Pteropus*.

A. vigilax, *C. annulirostris* and *C. p. fatigans* have transmitted Murray Valley encephalitis in the laboratory [*R.A.E.*, B **42** 15], and the last two are suspected vectors of this virus [**43** 133] and that of Japanese B encephalitis [**40** 86]. As these two viruses are immunologically related to dengue virus [*cf.* **49** 203], it seems probable that *A. vigilax*, *C. annulirostris* and *C. p. fatigans* are capable of transmitting dengue. *M. uniformis* and *C. sitiens* are probably also able to transmit dengue as other species of *Mansonia* have been found naturally infected with similar viruses [*cf.* **33** 69] and *C. sitiens* is closely related to *C. annulirostris*.

Pope (J. H.), Scott (W.) & Dwyer (R.). *Coxiella burneti* **in kangaroos and kangaroo ticks in western Queensland.**—*Aust. J. exp. Biol. med. Sci.* **38** no. 1 pp. 17–27, 1 map, 8 refs. Adelaide, 1960.

In reports of the occurrence of Q fever in men closely associated with sheep shearing in western Queensland, the infection was attributed to the presence of *Coxiella burneti* in the wool of sheep at the time of shearing. *Amblyomma triguttatum* Koch was also present on the sheep, and complement-fixing antibodies specific to *C. burneti* were present in the sera of one of three kangaroos caught in the area in which the outbreak occurred. Studies were therefore undertaken to determine the incidence of antibodies in kangaroos in western Queensland, and to investigate the rôle of *A. triguttatum* in the epidemiology of Q fever, and the following is taken mainly from the authors' summary of the results. Specific complement-fixing antibodies were present in 23 per cent. of the kangaroos collected, and agglutinins in 15 per cent. The percentages of grey kangaroos (*Macropus major*) showing the antibodies were 12 and of red kangaroos (*Megaleia rufa*) 33, rising in three areas to 46–54. *C. burneti* was isolated from the blood of a male *Macropus*, and 13 strains were isolated from 2,197 examples of *A. triguttatum* collected from kangaroos, goats and sheep. These results indicate that a natural kangaroo–tick cycle exists.

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van der Kuyp (E.). **Yellow fever in Surinam.**—*Trop. geogr. Med.* **10** no. 2 pp. 181–194, 22 refs. Amsterdam, 1958. (With summary in Spanish.)

The author describes the history and epidemiology of yellow fever in Dutch Guiana, dividing the country, from the results of mouse protection tests, into five areas. In the savannah area, jungle yellow fever is endemic; in the interior and the hinterland near the Brazilian border it affects the inhabitants in proportion to their contact with the forest. *Haemagogus equinus* Theo. and *H. spegazzinii* Brèthes are present and monkeys are common in these three areas. In the rural coastal area, which supports 50 per cent. of the population, jungle yellow fever occurs at a low rate, and it is thought that most infections are acquired in the savannah. In Paramaribo, the capital, with 40 per cent. of the population, the last epidemic of urban yellow fever was in 1908–09. Effective control of *Aëdes aegypti* (L.) was established gradually, water containers having been treated with DDT since 1948, and houses sprayed with DDT since 1949. The percentage of yards in which larvae of *A. aegypti* were found was 42·1 in 1948 and that of houses and yards in the same month (June) of 1957 was 2·1. More recently, these rates have risen, and laboratory tests show that resistance to DDT, but not to dieldrin or γ BHC, is present. The reasons why jungle yellow fever does not give rise to urban epidemics are discussed.

van den Assem (J.) & van Dijk (W. J. O. M.). **Distribution of Anopheline mosquitoes in Netherlands New-Guinea.**—*Trop. geogr. Med.* **10** no. 3 pp. 249–255, 3 maps, 8 refs. Amsterdam, 1958. (With a summary in Spanish.)

Records of the distribution of the Anophelines of Dutch New Guinea are summarised, including some already noticed [*R.A.E.*, B **33** 193; **35** 172; **41** 191; **44** 165]. Of 20 species recorded, six are regarded as invaders from the Oriental faunal region, the rest being Australian in origin, including the five most widespread species: *Anopheles farauti* Lav., *A. punctulatus* Dön., *A. koliensis* Owen, *A. longirostris* Brug and *A. bancroftii* Giles. The commonest species and the main vector of malaria is probably *A. farauti*, which is associated with *A. punctulatus* and *A. koliensis* north of the Central Mountain range, and with *A. bancroftii* south of it. The oriental species are not found south of the mountains, whereas some Australian species are confined to this area.

Laarman (J. J.). **The host-seeking behaviour of Anopheline mosquitoes.**—*Trop. geogr. Med.* **10** no. 4 pp. 293–305, 3 figs., 9 refs. Amsterdam, 1958. (With a summary in Spanish.)

The reactivity of females of *Anopheles labranchiae atroparvus* van Thiel, and the attractiveness to them of airborne stimuli, were studied with an air-current olfactometer [*cf.* *R.A.E.*, B **27** 166]. The responses of newly emerged, unfed females to the moisture content, carbon-dioxide content and temperature of the air and to air carrying the emanations from a rabbit, a human arm, human breath, the blood of rabbit and cow, and various combinations of these stimuli were compared. Two types of response were recorded, namely, alighting on the gauze covering the port of entry of the air current and hovering in front of it, the latter being regarded as a response to stimuli that did not induce alighting. Smell was found to play a large part in the location of the source of the blood-meal, and the smell of a source to which the strain of mosquito was accustomed was especially effective. Evidence that heat and moisture induce alighting, and that temperature gradients induce orientation, was obtained; the thermotaxis was strongly activated by odours and by carbon dioxide.

Janicki (M.), Dymowska (Z.) & Łukasiak (J.). **Malaria in Poland 1945–1955, with particular reference to its occurrence in Warsaw.**—*Trop. geogr. Med.* **10** no. 4 pp. 371–378, 3 graphs, 24 refs. Amsterdam, 1958. (With a summary in Spanish.)

The epidemics of malaria due to *Plasmodium vivax* that occurred in and near Warsaw in 1946–49 and earlier are discussed, and it is suggested that the morbidity curves indicate the presence of two subspecies of the parasite, *P. v. hibernans*, with a long incubation period and highest incidence in spring, and *P. v. vivax*, with a shorter incubation period and highest incidence in autumn. The former is regarded as indigenous, while the latter may occur sporadically in hot years. The Anophelines held responsible for transmission are *A. maculipennis maculipennis* Mg. (*typicus*), *A. m. messeae* Flni., *A. claviger* (Mg.) (*bifurcatus*, auct.) and *A. labranchiae* *atroparvus* van Thiel (*maculipennis atroparvus*), of which the first three were common in the Warsaw area during the last epidemic.

Lewis (D. J.). **Notes on** *Chrysops bicolor* **Cordier (Diptera: Tabanidae) in Tanganyika.**—*Proc. R. ent. Soc. Lond.* (A) **35** pt. 4–6 pp. 75–78, 14 figs., 14 refs. London, 1960.

Notes on observations made during dissection of 127 females of *Chrysops bicolor* Cordier taken biting man in Tanganyika in October and November 1958 include various characters useful in separating parous from nulliparous individuals. In the latter, the ovariole has a short terminal stalk with no obvious cellular structure, very different from the combined stalk and follicular relic of a parous fly in which the cellular structure of the stalk is clearly visible. An anterior concentration of central fat-body is a conspicuous network of grey cells in nulliparous females, whereas it has usually lost its reticulate appearance or else contains brown areas or spots in parous ones.

Saunders (D. S.). **The ovulation cycle in** *Glossina morsitans* **Westwood (Diptera: Muscidae) and a possible method of age determination for female tsetse flies by the examination of their ovaries.**—*Trans. R. ent. Soc. Lond.* **112** pt. 9 pp. 221–238, 7 figs., 32 refs. London, 1960.

An account is given of laboratory studies on the ovaries and ovulation cycle of *Glossina morsitans* Westw., made in view of the author's discovery that each ovary in this species (and in *G. palpalis* (R.-D.), *G. brevipalpis* Newst. and *G. pallidipes* Aust.) consists of two polytrophic ovarioles each containing one follicle. The sequence of development of the follicles [*cf. R.A.E.*, B **25** 135], the appearance of the follicular tube after ovulation, the development of the second follicle in an ovariole and follicular degeneration are described. After ovulation, the follicular tube at first resembles an open dilated sac, most of which later breaks away, leaving a small piece of tissue, the funicle stump [*cf.* **48** 218]. There was little tendency for virgin females of *G. morsitans* to retain mature eggs within the ovary, as those of *G. palpalis* seem to do [**25** 135], but follicles are significantly smaller in virgin than in pregnant flies.

A table for determining the age of a female at 26–27°C. [78·8–80·6°F.] by examination of the ovaries and uterine contents is given. When the uterus is empty and the largest follicle is in the right ovary, with no evidence of ovulation, the female is 1–4 days old if the largest follicle is less than 1 mm. long, 4–7 days old if the largest follicle is more than 1 mm. long and 7–8 days old if there is a fully developed egg that slips out of the follicular tube on dissection. When there is evidence of one ovulation in the right ovary and the largest follicle is in the left ovary, the female is 8–11 days old if the follicular tube in the right ovary appears as an open expanded sac and the uterus contains an egg, 12–14 days old if the right ovary contains an open sac and the uterus a small (first- or second-instar) larva, 15–16 days old if the ovariole in the right ovary shows the first signs of the descent of a second follicle and a funicle stump and there is a small larva in the uterus, 16–18 days old if the ovariole shows a fully descended second follicle and a funicle stump and the uterus contains a second- or third-instar larva with white lobes, 18–19 days old if the second follicle in the ovariole is 0·15 mm. long, the uterus contains a third-instar larva with black lobes and the left ovary contains a fully developed egg, and 19–20 days old if the larva has been deposited and the uterus is empty. The variation in this last age-group in the laboratory was 17–25 days but much of this variation is thought to be associated with laboratory culture and not to occur in the field. When there is evidence of two ovulations, one in the right ovary and one in the left, with the largest follicle in the right ovary, the female is in the second cycle and is about 20–30 days old, and the cycle can be subdivided by the stage of development of the larva in the uterus. When there is evidence of three ovulations, two in the right ovary and one in the left with the largest follicle in the left ovary, the female is in the third cycle and is about 30–40 days old. When there is evidence of four or more ovulations, two in each ovary, the female is more than about 40 days old, but after this it is impossible to determine the number of eggs produced.

van den Berghe (L.), Chardome (M.) & Peel (E.). **Les trypanosomes transmis par** *Glossina morsitans* **au Mutara (Ruanda).**—*Ann. Soc. belge Méd. trop.* **38** no. 5 pp. 965–970, 3 refs. Brussels, 1958. (With summaries in Flemish, English, German & Spanish.)

The following is virtually the authors' summary. The important rôle of *Glossina morsitans* Westw. in transmitting pathogenic trypanosomes of mammals has been established and confirmed in Mutara, Ruanda. A high concentration of cattle favours a high percentage of infection in the flies when compared with an area similar in all other respects. The percentages of flies infected by *Trypanosoma brucei* and *T. congolense* are lowest at the end of the rainy season and highest at the end of the dry season. The indices of infection with trypanosomes belonging to the groups of *T. brucei*, *T. congolense* and *T. vivax* are given, as well as those for *T. grayi*. It is essential to start dissection immediately after the death of tsetses killed by chloroform, as laboratory experience has shown that trypanosomes rapidly disappear in them.

Barrass (R.). **The settling of female** *Haematopota insidiatrix* **Austen (Diptera, Tabanidae) on cloth screens.**—*Ent. exp. appl.* **3** no. 4 pp. 257–266, 5 figs., 20 refs. Amsterdam, 1960. (With a summary in German.) **Erratum.**—*Op. cit.* **4** no. 1 p. 6. 1961.

The following is virtually the author's summary of this account of observations made in Wankie National Park, Southern Rhodesia. The response of the females of *Haematopota insidiatrix* Aust. to cloth screens [*R.A.E.*, B **49** 226] is considered as part of their host-finding behaviour. When black, dark grey, light grey and white cloths were compared as regards attractiveness, more flies settled on the black than on the other shades. When a screen was carried horizontally, flies settled on the under surface but not on the upper surface, and more flies were caught. A black screen with three white stripes was progressively less attractive as the width of the stripes was increased. Even narrow white stripes reduced the catch, particularly if they were horizontally arranged. When differently sized black screens were compared, fewer flies were caught on the smaller ones. Flies settled on the lower part of a screen, as they do on a host animal. When a screen was divided so that its lower half was white and its upper half black, fewer flies settled on it than on the all-black reverse side (control). Conversely, with black below white, approximately the same number of flies were caught on this as on the black or control side of the screen. At temperatures below

19°C. [66·2°F.] and relative humidities above 77 per cent., more flies settled on the sunny than on the shaded part of the screen. At higher temperatures and lower humidities, this preference was reversed.

Lien (J. C.). **Laboratory culture of** *Aedes* (*Finlaya*) *togoi* **(Theobald), 1907 and measurements of its susceptibility to insecticides.**—*Ent. exp. appl.* **3** no. 4 pp. 267–282, 2 graphs, 26 refs. Amsterdam, 1960. (With a summary in German.)

The following is based on the author's summary. The author reviews the literature on *Aëdes togoi* (Theo.) and describes the way in which this oriental mosquito was reared in London from eggs brought from Formosa in 1958. Methods similar to those commonly used for *A. aegypti* (L.) proved satisfactory. Data on bionomics are recorded, and tests are described in which the susceptibility of the adults and larvae to insecticides was measured and compared with that of laboratory colonies of *A. aegypti* from Formosa and the Pescadores.

Jung (H. F.). **A new phosphoric ester residual insecticide with a low order of toxicity.**—*Bull. World Hlth Org.* **21** no. 2 pp. 215–221, 2 figs., 6 refs. Geneva, 1959. (With a summary in French.)

The effectiveness of DDT and dieldrin as deposit insecticides is due partly to their stability and the fact that this is relatively independent of the materials to which they are applied. Many organophosphorus insecticides are inferior in these respects, but two have been developed that are resistant to alkalis and approach the chlorinated hydrocarbons in lasting effect. These are coumaphos (Bayer 21/199), which, however, is effective against only a very limited number of insects, and fenthion (S 1752, Bayer 29493 or Baytex), a brown liquid soluble in most organic solvents, practically insoluble in water, extremely fast to light and effective against a wide range of species [*cf. R.A.E.*, B **49** 31, 79, 149, 255]. The chemical and physical properties of fenthion are set out. It has LD50's for rats of 200–450 mg. per kg. by mouth [*cf.* **49** 239] and 125–220 mg. per kg. by intraperitoneal injection, and cats can tolerate 125 mg. per kg. by mouth without showing symptoms. Exposure for 48 hours to a concentration of 10 parts per million gives complete mortality of the fish, *Lebistes reticulatus*, but 1 p.p.m. gives no mortality. Exposure for 24 hours to 0·0005, 0·001, 0·005 and 0·01 p.p.m. gives 0, 20, 70 and 100 per cent. mortality, respectively, of larvae of *Aëdes aegypti* (L.).

In tests of the effectiveness of fenthion on various substrates, the toxicant was applied as a water-dispersible powder at 1·7 g. active ingredient per sq. m. to loam, 1·5 g. to burnt clay, 1·2 g. to plywood and 1 g. to glass (both plain and lime-coated in each case) on which insects of various kinds were subsequently exposed. Total mortality was given by exposure for one hour of unfed females of *A. aegypti* for two months on all substrates and for at least four months on all except loam and lime-coated burnt clay, by exposure for 8 hours of females of *Musca domestica* L. for three months on all substrates and for four on all except loam, by exposure for 24 and (in brackets) 48 hours of blood-fed adults of *Rhodnius prolixus* Stål for two weeks (two months) on all substrates and for four months (four months) on glass and plywood and by exposure for 24 hours of blood-fed adults of *Cimex lectularius* L. for three months on all substrates and for four months on all except loam. There was rarely much difference between results on a lime-coated substrate and the same substrate uncoated.

Beklemishev (W. N.) [V. N.], Detinova (T. S.) & Polovodova (V. P.). **Determination of physiological age in Anophelines and of age distribution in Anopheline populations in the USSR.**—*Bull. World Hlth Org.* **21** no. 2 pp. 223–232, 4 figs., 50 refs. Geneva, 1959. (With a summary in French.)

A detailed description is given of a technique, based on studies of species of the complex of *Anopheles maculipennis* Mg., whereby the physiological age of a female (the number of gonotrophic cycles through which it has passed) can be accurately determined by examination of the dilatations left in the ovarioles after each maturation of follicles and deposition of eggs. The number of dilatations per ovariole found on dissection usually corresponds exactly to the number of gonotrophic cycles. Tubes in which follicles have degenerated instead of forming mature eggs develop at first dilatations larger than normal, but the degenerated products are pushed out by the next mature egg at deposition and the dilatation then assumes the normal appearance; if, however, as only occasionally happens, a follicle fails to develop, no changes are left corresponding to that cycle. Thus, both normal and abortive oogeneses leave traces in the follicular tubes that make possible the accurate determination of the numbers of gonotrophic cycles passed through. Determination of the duration of the process of contraction of the distal end of the follicular tube and of the formation of dilatations after ejection of a mature egg (by dissection of empty or freshly fed females) makes it possible to determine the period elapsing between oviposition and a fresh blood-meal and therefore the whole gonotrophic cycle, instead of only the duration of blood digestion and egg development, as formerly.

By dissection of a large number of females, the age composition of a population and any changes in it in the course of a transmission season can be determined [*cf. R.A.E.*, B **45** 212]. With a knowledge of the temperature in mosquito shelters, the number of gonotrophic cycles that coincides with a single sporogonic cycle of the malaria parasite [*Plasmodium*] and thus the physiological age at which the salivary glands of females may contain sporozoites can be established. The proportion of potentially dangerous females at various periods of the season can also be determined, and the effectiveness of measures directed against malaria vectors in the adult stage can be assessed. The technique has been extensively used in the Soviet Union since 1947 [*cf. loc. cit.*]. Females of *A. m. messeae* Flni. have been found in the 13th gonotrophic cycle in various parts of the Union in which DDT has not been used, and L. V. Ivanova found a female of *A. superpictus* Grassi passing through the 14th cycle in Tadzhikistan.

The technique for distinguishing parous from nulliparous Anophelines by examination of the tracheoles of the ovaries, which undergo irreversible straightening [**34** 180], is also described.

Smith (A.). **Results of screening** *Anopheles gambiae* **for resistance to dieldrin in the Pare area of north-east Tanganyika.**—*Bull. World Hlth Org.* **21** no. 2 pp. 239–240, 3 refs. Geneva, 1959.

During the third year of an investigation of the effect of house spraying with dieldrin on malaria transmission in the Pare area of north-eastern Tanganyika [*R.A.E.*, B **48** 179–180], over 3,000 females of *Anopheles gambiae* Giles in all stages of ovarian development were collected from untreated huts and box shelters around cattle enclosures in swamp villages. To determine whether they had developed resistance of the type described by Davidson [**49** 93, etc.], they were exposed to test papers treated with 0·4 per cent. dieldrin used with the WHO test kit [**49** 199–200] or to papers with 0·5 per cent. dieldrin by the method of Busvine & Nash [**41** 156]. The only survivors were five from the huts and eight from the cattle enclosures, both from batches tested by the WHO method; one from each source gave rise to adult progeny, all of which were killed by one or other of the test methods. It is therefore concluded that resistance of the type described by Davidson cannot be present. Survival of the parents may have been due to vigour tolerance [**49** 231] or more probably to avoidance of the treated surface in the WHO apparatus.

SMITH (A.). **The susceptibility to dieldrin of** *Pulex irritans* **and** *Pediculus humanus corporis* **in the Pare area of north-east Tanganyika.**—*Bull. World Hlth Org.* **21** no. 2 pp. 240–241, 4 refs. Geneva, 1959.

In the Pare area of north-eastern Tanganyika, where an experiment on the effects of house spraying with dieldrin on the transmission of malaria has been in progress [*R.A.E.*, B **48** 179–180], beds have been sprayed as well as the interior surfaces of huts. The effect of the treatment on fleas (*Pulex irritans* L.) and lice (*Pediculus humanus humanus* L. (*P. h. corporis* Deg.)) was studied in roadside and swamp villages treated for the fifth time in July 1958 and for the sixth in February 1959. Nuisance from fleas was first detected in June 1958, about 2½ years after spraying began. In November 1958, 47 of 142 beds examined in the roadside villages were infested with adult fleas and four with nymphal or adult lice. Of 106 beds in the swamp villages, 43 had fleas and seven had lice. There were usually only 2–3 fleas and 1–2 lice per bed. In laboratory tests of susceptibility, batches of up to 20 fleas or third-instar or adult lice of both sexes were exposed for 24 hours in 3 × 1 in. tubes lined with treated papers, and their mortality, corrected for control mortality, estimated. As compared with *Xenopsylla cheopis* (Roths.) [**41** 157], *Pulex irritans* in north-eastern Tanganyika was shown to have a high natural resistance to dieldrin, which, at concentrations of up to 4 per cent. killed up to 26 per cent. of fleas from Pare in August–September 1958 and not more than 44 per cent. of those from an untreated area 30 miles away. By January 1959, the Pare fleas were as susceptible as those from the untreated area. In October 1958, dieldrin at 2 per cent. or more gave complete mortality of *Pediculus h. humanus* from an untreated area, but at 4 per cent. gave only 8 per cent. mortality of lice from Pare. Both lice and fleas from Pare were easily killed by DDT, which gave mortality of 100 per cent. in the former and 94 per cent. in the latter, at 4 per cent., corresponding figures for 1 per cent. being 81 and 41.

CROSSKEY (R. W.). **Aspects of black-fly control and entomology in the New World in relation to the** *Simulium* **problem in Nigeria.**—*Bull. World Hlth Org.* **21** no. 6 pp. 727–736, 17 refs. Geneva, 1959. (With a summary in French.)

The following is substantially the author's synopsis. A general account is given of insecticidal control of Simuliids in Canada [*cf. R.A.E.*, B **49** 279], the United States [*cf.* **48** 14] and Mexico, and the problems are contrasted with those arising in the control of *Simulium damnosum* Theo. in

Nigeria. Some recent observations on the bionomics of Canadian Simuliids are described [*cf.* **49** 244], and it is emphasised that these have materially contributed to successful control. It is pointed out that control of *S. damnosum* is being carried out without much fundamental biological knowledge of the species. The epidemiology of onchocercosis (caused by *Onchocerca volvulus*) and the biology of the vector species of *Simulium* in Mexico [*cf.* **35** 16, 182] and Guatemala [*cf.* **48** 34, etc.] are discussed and compared with *S. damnosum* and its relationship to onchocercosis in Nigeria.

MSANGI (A. S.). **The value of a spreading agent in larvicidal formulations containing DDT.**—*Bull. World Hlth Org.* **21** no. 6 pp. 773–778, 4 refs. Geneva, 1959. (With a summary in French.)

The following is substantially the author's synopsis. The value of a spreading agent in a 5 per cent. solution of DDT in oil as a mosquito larvicide was assessed under semi-field conditions against third-instar larvae of *Anopheles gambiae* Giles. The larvae were treated with known dosages of the larvicide with and without the addition of a spreading agent, and the mortalities produced by the two forms of the larvicide were compared. An attempt was also made to compare the efficacy of the two forms under field conditions. The trials described seem to have shown conclusively that there is no advantage to be gained by adding spreading agents to a 5 per cent. solution of DDT in oil.

MILES (J. A. R.). **Epidemiology of the arthropod-borne encephalitides.**—*Bull. World Hlth Org.* **22** no. 3–4 pp. 339–371, 3½ pp. refs. Geneva, 1960. (With a summary in French.)

This paper consists of a review of knowledge of the host and vector relations of mosquito- and tick-borne encephalitis viruses and of the distribution and control of the various diseases they cause in man and domestic animals.

LABRECQUE (G. C.), GAHAN (J. B.) & NOE (J. R.). **Toxicity of some new organic phosphorus compounds to Anopheline larvae.**—*Proc. N. J. Mosq. Ext. Ass.* **43** pp. 172–175, 2 refs. [New Brunswick, N.J.] 1956.

In 1954 and 1955, over 900 chemicals were tested against fourth-instar larvae of *Anopheles quadrimaculatus* Say in the laboratory by addition of acetone solutions to distilled water. DDT was used as the standard of comparison, and the following is taken mainly from the authors' summary of the results. Dimethyl 1,2,2,2-tetrachloroethyl phosphate, Am. Cyanamid 12009 [O,O-diethyl S-propylthiomethyl phosphorodithioate] and Am. Cyanamid 12008 [O,O-diethyl S-isopropylthiomethyl phosphorodithioate] were the most effective materials. Am. Cyanamid 12009 was the best of a selected group applied to roadside ditches near Orlando, Florida, that were naturally infested with larvae of *A. crucians* Wied. and *A. quadrimaculatus*, and compared favourably with the best larvicides ever tested against *Anopheles* larvae [*cf. R.A.E.*, B **43** 117] in this area, giving over 95 per cent. control at dosages as low as 0·0025 lb. per acre.

Burbutis (P. P.) & Jobbins (D. M.). **The comparative toxicity of malathion, dieldrin, and DDT to** *Aedes aegypti* **larvae in polluted and tap water.**—*Proc. N.J. Mosq. Ext. Ass.* **45** pp. 112–117, 2 graphs, 3 refs. [New Brunswick, N.J.] 1958.

Tests were carried out to compare the acute and residual toxicities of malathion, dieldrin and DDT to larvae of *Aëdes aegypti* (L.) when applied in oil to tap water and to polluted water taken from a sewage plant. Acute toxicity was determined by exposure of the larvae in water in pans to which the toxicant was added after the larvae had been induced to settle at the bottom, and residual toxicity by introducing the larvae into the pans through a fine-stemmed funnel 9–10 days after the insecticide had been added to the surface of the water. Mortality was observed 48 hours after the addition of the larvae. The following is taken from the authors' discussion and conclusions. The acute toxicity of dieldrin and DDT at the LD95 level appeared less in the polluted water than it was in the tap water. This is thought to be due to the increased vigour of the larvae, which had access to whatever food was available in the polluted water [*cf. R.A.E.*, B **35** 56], whereas the starvation of those in tap water, which had no food for a test period lasting nearly half their life, may have rendered them more susceptible to the toxicants, especially at the higher concentrations. The adsorption of DDT by organic material may be another factor responsible for the apparent decrease in the toxicity of this insecticide in polluted water. There was no significant decrease in the toxicity of dieldrin or DDT 9–10 days after application to either type of water, but the residual toxicity of malathion was less in the polluted water than in the tap water, and this may be due to metabolism of the toxicant by micro-organisms in the former [*cf.* A **47** 61].

Eastin (J. L.) & Burden (G. S.). **Tests with five silica dusts against German cockroaches.**—*Florida Ent.* **43** no. 3 pp. 99–102, 1 fig., 4 refs. Gainesville, Fla., 1960.

An account is given of investigations in Florida in which silica dusts were tested for the control of *Blattella germanica* (L.) [*cf. R.A.E.*, B **48** 207]. When batches of ten adult males eight weeks old were exposed for 30 minutes to plywood panels treated with five such dusts at 100–500 mg. per sq. ft. and observed for mortality after 48 hours, CAB-O-SIL (a silica smoke), SG-67 (a coated, finely divided silica with 4·7 per cent. ammonium fluosilicate present as a monomolecular layer) and SG-68 (an uncoated, finely divided silica) gave the lowest LD50 values; at the LD90 level, SG-67 and SG-68 were more effective than the rest. Talc dusts containing 10 per cent. Estersil-1 (a surface-esterified amorphous silica), SG-67 or SG-68, alone or with 2 per cent. malathion, were compared with 2 per cent. malathion alone, at rates of 250 (except for Estersil-1), 500 and 1,000 mg. per sq. ft. on similar panels. The combinations of SG-67 and SG-68 with malathion were more effective than malathion alone, but Estersil-1 with malathion was only about as effective as malathion alone and the silica dusts alone were ineffective. When dusts were applied in dwelling houses, the percentage reductions in population, as compared with the numbers before treatment, were 93 for 1 per cent. diazinon, 86 for SG-67, 82 for Estersil-1 and 29 for SG-68, after one day, and 91, 69, 60 and 0, respectively, after 29–30 days.

Edwards (D. K.). **A method for continuous determination of displacement activity in a group of flying insects.**—*Canad. J. Zool.* **38** no. 6 pp. 1021–1025, 3 figs., 4 refs. Ottawa, 1960.

The following is almost entirely the author's abstract. A method is described for obtaining a continuous record of the amount of flight activity occurring in a group of flying insects. The test insects, which in the author's experiments were *Calliphora vicina* R.-D., are kept in an earthed metal cage. When an insect flies, it accumulates a positive charge on its body. This charge influences a sensitive electrometer-probe in the centre of the cage. The impulse resulting from the flight is amplified by the electrometer and is recorded as a deflection on a pen-recorder chart. An activity curve for the test insects can be plotted from counts of the number of deflections in a given time.

Edwards (D. K.). **Effects of artificially produced atmospheric electrical fields upon the activity of some adult Diptera.**—*Canad. J. Zool.* **38** no. 5 pp. 899–912, 3 graphs, 20 refs. Ottawa, 1960. **Effects of experimentally altered unipolar air-ion density upon the amount of activity of the blowfly,** *Calliphora vicina* **R.D.**—*T. c.* no. 6 pp. 1079–1091, 3 figs., 27 refs.

In an endeavour to explain changes in insect behaviour before thunderstorms, two aspects of atmospheric electricity were studied in relation to insect movement, and the findings are recorded in these papers. The following paragraphs are based largely on the author's summaries.

The first paper contains an account of experiments on the effect of the potential gradient or electrical field, carried out with *Drosophila melanogaster* Mg. and *Calliphora vicina* R.-D. The term electrical field here refers to the lines of force joining opposite electrical charges on the surface of the earth and in the upper atmosphere. During fair weather, the positive pole is in the upper atmosphere, the earth being negative; this produces a positive field. Changes in sign and value of the electrical field are associated with certain types of weather. The term potential gradient or potential to earth refers to the change with height above the earth's surface of the field intensity. Activity (walking) in *D. melanogaster* was temporarily reduced by sudden exposure to a potential gradient as low as 10–62·5 volts per cm. and of constant polarity. The period of reduced activity was prolonged if the field polarity was reversed every five minutes. Reduction in the activity of *C. vicina* was much more transient, and a much stronger field was necessary to produce the effect. These results do not support the view that increases in insect activity before storms are related to disturbances in potential gradient. The possibility of effects of insect size on the response to an electrical field is discussed.

In the second paper, a study of the effect of changes in the density of artificially applied positive or negative air ions on the activity of *C. vicina* is described. Small ions, or drifting charged particles, are produced in normal, free air by various factors, including cosmic radiation, electrical point-discharges, radioactive elements in the soil and atomisation of water. When barometric pressure is lowered, certain radioactive gases are withdrawn with the air from the soil, and air ions increase in consequence; different densities of air ions are associated with different kinds of weather. Increased positive air-ion densities increased the flight activity of *C. vicina*, which reached a peak about 45 min. after first exposure when the potential of the ion-source was 345 volts, but returned to the original level while the flies were still exposed; the effect was less when the ion-source potential was 115 volts, and with a similar negative-ion density, no effect was observed.

West (A. S.), Brown (A. W. A.) & Peterson (D. G.). **Control of black fly larvae (Diptera: Simuliidae) in the forests of eastern Canada by aircraft spraying.**—*Canad. Ent.* **92** no. 10 pp. 745–754, 1 graph, 7 refs. Ottawa, 1960.

In 1954, an experiment was carried out in a forest area on the north shore of the St. Lawrence near Baie Comeau, Quebec, to determine whether the application of DDT spray from aircraft to the periphery of a drainage basin would result in deposition of enough DDT in the streams within the basin to control Simuliid larvae and reduce the subsequent numbers of adults. The results were unsatisfactory, as only half the streams in the basin had their sources at or near the periphery and received enough DDT to affect the larvae. The subsequent adult population was not noticeably reduced, since large numbers emerged from streams unaffected by the treatment. Later in the season, adults emerged even from the treated streams.

The effectiveness of DDT spray applied from aircraft in swaths ¼ mile wide against Simuliid larvae was demonstrated in experiments carried out in 1955 and 1956. In 1955, two plots in the Wood River basin in which at least ten species of Simuliids were present, complexes of *Prosimulium hirtipes* (Fries) and *Simulium venustum* Say being by far the commonest, were sprayed at 4 and 18·3 lb. DDT per flight-mile, respectively. Three streams in one of the plots were not treated, two because they were situated between spray swaths and the third owing to an error, and larvae survived in these. Larvae were nearly or completely eliminated from all efficiently treated streams. In 1956, the entire drainage basin was sprayed from commercial aircraft fitted with boom-type spray apparatus at rates averaging 14·1 lb. DDT per flight-mile; the operation was completed on 2nd June before most of the larvae of the overwintering brood of the *hirtipes* complex had pupated and when larvae of the *venustum* complex were very small. Streams used for driving pulpwood were treated from the ground at 0·1 part DDT per million, after the completion of the drive, if larval populations were increasing. In the immediate post-spraying period, larvae were found in only one small stream of the 65 examined in the Wood River basin. It was concluded from observations of adult activity that there was hardly any emergence from streams within the sprayed area until mid-July. In contrast, emergence of adults in numbers began in unsprayed areas about 10th June, and peak populations were recorded before 1st July.

Wright (R. H.). **The olfactory guidance of flying insects.**—*Canad. Ent.* **90** no. 2 pp. 81–89, 4 figs., 11 refs. Ottawa, 1958.

Wright (R. H.) & Rayner (H. B.). **The olfactory guidance of flying insects. II. Mosquito repulsion.**—*Op. cit.* **92** no. 11 pp. 812–817, 13 figs. 1960.

The first of these papers is a theoretical consideration of the perception of scents by flying insects and the attraction of flying insects to a source of odour.

In the second, an account is given of work in which the flight behaviour of females of *Aëdes aegypti* (L.) in a wind tunnel with a translucent back and illuminated from behind was recorded with a cinematograph camera; a study of the film, on which the mosquitos appeared as silhouettes, showed that the presence of a repellent (dimethyl phthalate) in the air in the tunnel caused some inhibition of turning, which was postulated in the first paper as a possible basis for attraction. It is suggested that, for attraction, the period of inhibition should be of the same order of magnitude as the interval between the pulses of smell from different filaments of odorous material, whereas, for repulsion, it should be much longer, so that the insect flies so far out of the odorous cloud that it does not readily find its way back when the normal turning pattern of flight is resumed.

FREDEEN (F. J. H.). **A trap for studying the attacking behaviour of black flies,** *Simulium arcticum* **Mall.**—*Canad. Ent.* **93** no. 1 pp. 73–78, 5 figs., 7 refs. Ottawa, 1961.

Hitherto, it has been possible to collect adults of *Simulium arcticum* Mall. in Saskatchewan only in light-traps at night and from animals in the daytime. The tendency of blood-seeking females of this species to assemble near animals and other objects, to attack on the ventral surface and to move readily towards a bright light in a dark enclosure formed the basis on which a new trap, termed a silhouette trap, was devised. Fundamentally, it consists of a four-legged frame with the upper two-thirds and the top covered with dark-brown plywood or dark-blue denim cloth, the underside left open and direct sunlight admitted to the dark interior only through an opening in the top, over which a clear plastic cone and removable inverted glass jar are fitted. Specifications are given for three forms of the trap, designated, respectively, cow, sheep and pyramid silhouette traps. These were tested in a pasture near Saskatoon over the greater part of the season of Simuliid activity in the summer of 1957. The effectiveness of the three forms was found to be a direct function of surface area and size of undersurface opening rather than shape. A light-trap operated from 6 p.m. to 6 a.m. collected more than twice as many Simuliids during a 105-day test period as did the next most successful, the cow silhouette trap. However, since a little more than half the season's catch of Simuliids in the silhouette traps was made on the four days during which local animals were attacked most severely, whereas some of the largest collections in the light-traps were made on days when livestock were not severely attacked, collections from the silhouette traps were more representative of the attacking population, and it is suggested that these may be used to investigate quantitatively the behaviour of blood-seeking females of *S. arcticum* and other species that attack large animals on the underside. Moreover, they can be used in areas not served by electricity and they do not need baits. Tabanids and mosquitos, which were observed attacking animals in the neighbourhood of the traps, were not found in them.

WEINTRAUB (J.). **Inducing mating and oviposition of the warble flies** *Hypoderma bovis* (**L.**) **and** *H. lineatum* (**De Vill.**) (**Diptera: Oestridae**) **in captivity.**—*Canad. Ent.* **93** no. 2 pp. 149–156, 10 figs., 20 refs. Ottawa, 1961.

The following is substantially the author's summary of this account of procedures by which adults of *Hypoderma bovis* (Deg.) and *H. lineatum*

(Vill.) were induced to pair in the laboratory [*cf. R.A.E.*, B **49** 253]. A pair of newly emerged flies that have voided meconial fluid and have hardened to flight condition are flown on short threads attached to the mesothorax with paraffin wax and are allowed to make contact repeatedly until the male genitalia become active and the ovipositor is grasped; the flies are then lowered to a surface to complete copulation. In a second method, the male is decapitated and its genitalia are stroked against the ovipositor until they become active; the male is then moved into position to clasp the ovipositor in copulation. To induce oviposition, the tethered mated female is made to fly and settle on hairy cowhide a few times until its ovipositor becomes active, and thereafter oviposition usually occurs whenever the fly is allowed to land. The female of *H. lineatum* moves backwards on the hide and makes a series of thrusts with its ovipositor until a hair is grasped upon which a row of eggs is deposited. A flight is usually, though not always, necessary before eggs are deposited on other hairs. The female of *H. bovis* deposits a single egg at the base of a hair immediately on contacting the hide, and it must be flown briefly before each egg is deposited. Flies behave in a similar way during induced mating and oviposition and during the same operations in the field. The effectiveness of induced infestations on test cattle is evaluated by examining the oviposition sites for hatching of the eggs and for the presence of the 'hypodermal rash'. The effectiveness of fertilisation is determined by examining the spermathecae of females for the presence of sperm.

JORDAN (A. M.). **An assessment of the economic importance of the tsetse species of southern Nigeria and the Southern Cameroons based on their trypanosome infection rates and ecology.**—*Bull. ent. Res.* **52** pt. 3 pp. 431–441, 1 map, 18 refs. London, 1961.

The following is mainly based on the author's summary. Previous records and new data on rates of infection with trypanosomes in species of *Glossina* inhabiting southern Nigeria and the Southern Cameroons are given and the probable economic importance of each species is assessed. Infection with trypanosomes pathogenic to cattle was highest in species of tsetse that fed largely on wild Bovids, including antelopes. The rarity of Gambian sleeping sickness [caused by *Trypanosoma gambiense*] in man in these regions is attributed largely to the impersonal nature of the contact between man and fly [*cf. R.A.E.*, B **48** 151]. *G. palpalis* (R.-D.), which is widespread, is not considered to be an important vector of sleeping sickness, as it is in Northern Nigeria, or of cattle trypanosomiasis, although some cases of the latter occur in cattle in areas where it is the only species of tsetse present. Little information is available on *G. tachinoides* Westw. and *G. caliginea* Aust.; both have probably been at least partly responsible for some of the rare outbreaks of sleeping sickness reported from the south, and the first may be of some significance as a vector of trypanosomiasis among domestic animals. The infection rate in *G. longipalpis* Wied. at the field station at Ugbobigha, in the Western Region of Nigeria, was 21·5 per cent.; this species is believed to be of major economic importance, because its presence prevents the keeping of cattle in large areas of potential grazing. In southern Nigeria, 13–24 per cent. of the examples of *G. medicorum* Aust., *G. fusca* (Wlk.) and *G. nigrofusca* Newst. that were examined were infected, and the first two species are considered to be of economic importance because they penetrate potential grazing areas; the last two species occur in the Southern Cameroons also. *G. pallicera* Big., *G. tabaniformis* Westw. and *G. haningtoni* Newst.

are confined to rain-forest, in both Nigeria and the Southern Cameroons, and were found to be only lightly infected; they are therefore not considered to be of economic importance, except possibly in the infection of cattle on trade routes. No data are available for *G. nashi* Potts, which inhabits the rain-forest of the Southern Cameroons [*cf.* **45** 23, 206].

Tharumarajah (K.) & Thevasagayam (E. S.). **A simple method for breeding the house-fly, *Musca domestica vicina* Macquart, in the laboratory.**—*Bull. ent. Res.* **52** pt. 3 pp. 457–458, 6 refs. London, 1961.

The following is virtually the authors' summary. Coconut poonac, the cake left after the extraction of oil from coconut pulp, has been used very successfully for breeding *Musca domestica vicina* Macq. in the laboratory in Ceylon. The females oviposit in the poonac, and the larvae live and pupate in the same medium.

Burnett (G. F.). **The susceptibility of tsetse flies to topical applications of insecticides. I. Young adults of *Glossina morsitans* Westw. and chlorinated hydrocarbons.**—*Bull. ent. Res.* **52** pt. 3 pp. 531–539, 2 graphs, 13 refs. London, 1961.

The following is substantially the author's summary. Solutions of six chlorinated-hydrocarbon insecticides in kerosene were applied in drops of about 0·02 μl. to adults of *Glossina morsitans* Westw., 2–5 days old, one day after their first meal. The flies used were from pupae collected in the field in Tanganyika and were found to be unusually susceptible to this group of insecticides. In order of increasing toxicity, the materials tested were DDT, aldrin, γ BHC, dieldrin and endrin (which were about equally toxic), and Telodrin (1,3,4,5,6,7,8,8-octachloro-3a,4,7,7a-tetrahydro-4,7-methanophthalan). The LD50 of DDT was 0·0165 μg. for males and 0·025 μg. for females, and that of Telodrin was 0·00062 μg. for males. Susceptibility of the two sexes to DDT, γ BHC and dieldrin did not differ significantly. Eight months after the first tests with dieldrin and γ BHC, the LD50's of these insecticides had approximately doubled, but the response to DDT was unchanged; the difference was not seasonal. It is concluded that dieldrin is the best and cheapest available insecticide for practical use, and this was confirmed in the field; only Telodrin might replace it.

Wood (R. J.). **Oviposition in DDT-resistant and susceptible strains of *Aëdes aegypti* (L.) in relation to light preference.**—*Bull. ent. Res.* **52** pt. 3 pp. 541–560, 3 graphs, 33 refs. London, 1961.

The following is substantially the author's summary. Three DDT-resistant strains of *Aëdes aegypti* (L.) (one from Haiti and one from Trinidad [*R.A.E.*, B **48** 237, etc.] and a third selected in the laboratory from the Trinidad strain [**48** 139]) and four susceptible strains (two originating in West Africa, one from the United States and one (var. *queenslandensis* (Theo.)) from Arabia) were investigated with respect to their attraction to oviposition sites illuminated at different intensities [*cf.* **48** 139]. The resistant strains tended to choose the darker sites (those illuminated at 0·02 lumen per sq. ft.

and below) and susceptible strains those illuminated at 3·5–6·5 lumens. Crosses between a 'dark-laying' (resistant) strain and a 'light-laying' (susceptible) strain indicated that light laying was fully dominant over dark laying, and it is suggested that the mechanism involved is probably simple. No linkage with the gene for physiological resistance to DDT could be demonstrated. The degree of expression of this character varied in certain circumstances, with a tendency among most strains to lay at darker sites after the second and subsequent blood-meals. In spite of these variations, behaviour at any one time remained reasonably predictable. The reflectance of the oviposition site did not appear to be important in determining the difference in behaviour between dark-laying and light-laying strains. On the contrary, it seemed probable that dark-laying strains were attracted to the dark situation in which the dimly-lit site occurred rather than to the site itself. There was some evidence of exploratory activity in the initial stages of oviposition by a dark-laying strain. The general resting habits of two strains differing markedly in oviposition habit proved very similar; for both strains, 0·1 lumen per sq. ft. was apparently too low to be attractive and 12 lumens too high. Resting behaviour did not appear to be under such critical control by light as was oviposition. Possible explanations for the differences in oviposition behaviour are discussed.

HARLEY (J. M. B.) & PILSON (R. D.). **An experiment in the use of discriminative clearing for the control of** *Glossina morsitans* **Westw. in Ankole, Uganda.**—*Bull. ent. Res.* **52** pt. 3 pp. 561–576, 5 maps, 22 refs. London, 1961.

In 1952, a pilot reclamation scheme was begun in the Ankole District of Uganda to find and apply a discriminative-clearing technique [*cf. R.A.E.*, B **43** 90] that would halt an advance of *Glossina morsitans* Westw. and eradicate the fly from an area of some 260 sq. miles of wooded grassland with *Acacia*. The felling of all trees that were over 20 ft. tall and belonged to the species of *Acacia* (*A. gerrardii*) that was the main constituent of the upper storey of the vegetation of the concentration sites of the fly seemed to give promising results, and fly densities fell to a low level [*cf.* **44** 116], but later on and further south, the effect was less marked. The fly-belt extended to the north and east of the area of the pilot scheme, and it became evident that more comprehensive clearing would be necessary in many areas to achieve eradication. Further clearing was carried out, culminating in late 1957 with the felling of all upper-storey trees of the double-storeyed vegetation, irrespective of height, in a belt 6–14 miles wide inside much of the eastern border of Ankole, in an attempt to confine the flies. As it was intended to apply this degree of clearing to all areas in which tsetse remained, an investigation was carried out in 1958–59, in an area 48¼ sq. miles in extent, to determine whether it would result in eradication.

The following is based on the authors' summary of the results. In the eastern part of the area, where the more intensive type of clearing had been carried out, though not completely, density of *G. morsitans* was low, and it seemed that the population was perhaps being maintained by immigration from the adjacent western part, where clearing had been less intensive and in parts of which fly density was relatively high. The application of the more intensive clearing to the western part, together with its completion in the eastern, failed to result in any marked effect on the tsetse population except as regards its distribution, *G. morsitans* now being found to concentrate in groups of *Acacia* trees of another species (*A. hockii*), 12–18 ft. high, which had appeared to be of little importance to the fly before clearing. A year after the treatment of the western part of the area, there was no apparent reduction in fly density. The feeding habits of the flies and rate of utilisation of their reserves showed no significant change as a result of clearing.

It seems that the failure of discriminative clearing as applied in this area, compared with the effect produced by less intensive clearing elsewhere in Ankole, is due to the presence in this area alone of the groups of moderately tall examples of *A. hockii*.

Smith (I. M.) & Rennison (B. D.). **Studies of the sampling of** *Glossina pallidipes* **Aust. III. The hunger stages of male flies caught on cattle and in Morris traps.**—*Bull. ent. Res.* **52** pt. 3 pp. 601–607, 15 refs. London, 1961.

Rennison (B. D.) & Smith (I. M.). **IV. Some aspects of the use of Morris traps.**—*T. c.* pp. 609–619, 16 refs.

The following paragraphs are based on the authors' summaries of these two papers, which continue a series on sampling populations of *Glossina pallidipes* Aust. [*R.A.E.*, B **49** 130].

In the first of two experiments in south-eastern Uganda, in which non-teneral males of *G. pallidipes* were caught concurrently on oxen and in Morris traps [**49** 20–21, etc.] and classified, within 1½ hours of capture, according to a modification of the hunger-stage categories described by Jackson [*cf.* **25** 162], the assessments made by individual recorders showed marked differences. In consequence, no conclusions could be drawn as to the hunger stage of flies taken by different attractants [*cf.* **29** 109]. The second experiment was designed in such a way as to discount possible bias among recorders, and it was found that the proportions of hungry flies (in stages III–IV) were similar on variously coloured individual oxen and generally higher than in trap catches, in which the proportions varied widely. As all the traps appeared identical, no generalisation is possible as to the mechanism by which non-teneral males are attracted to and induced to enter such traps.

Experiments in south-eastern Uganda on factors influencing the catch of *G. pallidipes* in Morris traps showed that variation of the interval at which the traps were emptied from 1½ to 24 hours or varying the width of the entrance slit from ¼ to 1½ in. did not significantly affect the catch. Such exceptions as occurred could be attributed to unexplained variations in the intrinsic performance of individual traps. Hardly any flies were taken between 6.30 p.m. and 6.30 a.m. Catches were lower in traps in which the sleeve had been left open to varying degrees or in which holes had been made in the gauze than in perfect traps. The catch was not significantly affected by the diameter of the sleeve opening but was significantly lower in traps with 16 ½-in. holes in the cage gauze than in those with 2, 4 or 8 holes. Escapes through such holes were observed while the traps were being emptied, when the recorder's approach disturbed the otherwise inactive trapped flies. Frequent visits to the traps to empty them did not materially increase the number of flies effectively trapped. The grounds for suggesting that the observer draws flies to the traps seem doubtful, for there is no indication that the section of the fly population attracted to man is also attracted to a trap. When the interval at which the traps were emptied exceeded 24 hours, trapped flies were lost to an unknown but sometimes substantial extent, as a result of predation by ants; this is the most likely source of significant variation in catches made by apparently identical traps, and can be overcome by mounting traps on greased, single legs. There was no significant difference in catch between traps so protected that were cleared at intervals ranging from 12 hours to eight days. The longer this interval, the greater the proportion of dead amongst captured flies; the median length of life after capture was about two days, this period varying slightly with sex and more substantially with undefined differences between sites and trapping periods.

Morris (K. R. S.). **Studies on the epidemiology of sleeping sickness in East Africa. II. Sleeping sickness in Kenya.**—*Trans. R. Soc. trop. Med. Hyg.* **54** no. 1 pp. 71–86, 4 maps, 20 refs. London, 1960.

The following is based largely on the author's summary of this second paper of a series on the epidemiology of sleeping sickness in East Africa, the first of which has already been noticed [*R.A.E.*, B **49** 247]. This study of sleeping sickness in Kenya is based on the literature and official records of the disease and on first-hand investigations of endemic areas in Central and South Nyanza in 1957. Sleeping sickness is confined to the Nyanza Province, where *Trypanosoma gambiense* was introduced from Uganda in 1902 and spread rapidly along the shores of Lake Victoria as far as the Tanganyika border, along the southern shores of the Kavirondo Gulf, and up the Kuja and Migori rivers. The epidemic was checked between 1909 and 1912 by moving the human population from the habitat of the vector, *Glossina palpalis* (R.-D.) [represented by subsp. *fuscipes* Newst.], along the lake shores and rivers, and thus breaking the close contact between them. However, infection persisted and spread inland, giving rise to epidemics from time to time. On the Kuja river, cases began to appear in numbers in 1943, and an epidemic rapidly developed, nearly 300 cases being reported for 1948. By 1954, most of the main river and its tributaries were involved. Simultaneous epidemics developed on the Nyando river, in the Kibigori area, with 287 cases in 1949–50, and in Central Nyanza in the Kadimu and Alego locations, with 70 cases or more. The Nyando outbreak was dealt with by the elimination of the whole population of *G. palpalis*, an isolated one, by spraying the river and its tributaries with DDT [**46** 189]. The Kadimu-Alego epidemic was equally effectively arrested by clearing the vegetation of the whole riparian habitat of *G. palpalis* throughout the infected area, but a mild epidemic, with 50–100 cases a year, moved southwards down the shores of Lake Victoria from Sakwa to Uyoma.

In 1957, sleeping sickness caused by *T. gambiense* persisted at a low endemic level in three parts of the Nyanza Province: on the Nyando river, where 5–6 cases a year represented a residue of slowly developing infections incurred before *Glossina* was eradicated; on the Kuja river system, where transmission is still occurring [*cf.* **48** 158], mainly on headwaters and side streams; and in the Sakwa-Uyoma Peninsula, where the transmission of infections was found to be taking place at four or five discrete and very circumscribed lake-shore foci. A fourth locality, the Samia location adjoining the Uganda border, may have some *T. gambiense*, and certainly has *T. rhodesiense* transmitted by *G. pallidipes* Aust. and is continuous with a similarly infected area in Uganda. This is a potentially dangerous situation, and further investigations on the nature and extent of the problem and possible methods of control are needed.

The epidemiology of *T. gambiense* in Nyanza is discussed, and particularly the mechanism by which endemic foci persist; these foci have maintained the disease, sometimes at a very low incidence, for periods up to 50 years, and from them have arisen the periodic epidemics. It is concluded that periods of very low endemicity, such as that obtaining in 1957, offer excellent opportunities for the complete eradication of the disease.

Morris (K. R. S.). **Studies on the epidemiology of sleeping sickness in East Africa. III. The endemic area of Lakes Edward and George in Uganda.**—*Trans. R. Soc. trop. Med. Hyg.* **54** no. 3 pp. 212–224, 2 figs., 15 refs. London, 1960.

The following is based mainly on the author's summary of this third paper of a series [*cf.* preceding abstract, etc.]. An area of endemic sleeping sickness caused by *Trypanosoma gambiense* developed to the north of Lake Edward in the Toro District of western Uganda at the beginning of this century, as an extension of an endemo-epidemic in the Belgian Congo. The latter was eventually controlled by evacuation of the human population in 1924–25. There was an epidemic in Uganda near Lakes Edward and George in 1910, and 1,500 sq. miles of country bordering these lakes have been demarcated as a sleeping sickness area since 1913. In 1932, there was an epidemic in Busongora County, in this area, 12 miles north of Lake Edward; this epidemic was reduced to a low level within three years by clearing river vegetation infested with *Glossina palpalis* (R.-D.) [represented by subsp. *fuscipes* Newst.] and by treatment of cases. Another epidemic in 1942 spread more widely, but control was effected by similar measures. The disease persisted in a state of low endemicity with 1–4 cases a year from 1949 to 1955, since when there have been no cases. Experimental spraying on the Bukangara river in 1955 eliminated *G. palpalis* completely though temporarily. Busongora shows a picture, frequent in *gambiense* trypanosomiasis, of periods of low endemicity, based on restricted foci, alternating with epidemic outbreaks. The endemics were restricted to an area of 12 × 3–4 miles in which the concentration of the population and the distribution of *G. palpalis* on many small streams brought about such close man–fly contact [*R.A.E.*, B **48** 151, etc.] as to present ideal conditions for the transmission and spread of sleeping sickness. Periods of very low endemicity, sometimes with no recorded cases just before the epidemic outbreaks, can be explained by the mildness of the disease, which nevertheless provides unsuspected sources of infection for the fly, a tendency for treated cases to relapse, and underestimation of the true incidence through incomplete detection and recording of cases. The present incidence, however, is certainly very low.

Nye (E. R.) & Lien (J. C.). **Laboratory transmission of Semliki Forest virus by** *Aedes togoi* **Theo.**—*Trans. R. Soc. trop. Med. Hyg.* **54** no. 3 pp. 263–264, 7 refs. London, 1960.

Aëdes togoi (Theo.) has been shown to be capable of laboratory transmission of Japanese B encephalitis [*R.A.E.*, B **40** 162–163], a member of the B group of viruses [**49** 203]. An account is given in this paper of experiments in which females of *A. togoi* acquired Semliki Forest virus, a member of the A group, by feeding on infected mice, and transmitted the infection to suckling mice by bite seven and 30 days later. Virus levels of at least 10^4 mouse-intracerebral LD50's [*cf.* **44** 38] were found in the mosquitos daily up to the seventh day and of $10^{3\cdot7}$ on the 31st day after an infecting feed. Although exact end-points for virus levels were not obtained for the first four days, a marked eclipse phase, as noted by other workers for Semliki

Forest virus in *A. aegypti* (L.) [**43** 65; **49** 248], was not apparent in this single experiment with *A. togoi*. Attempts to demonstrate transovarial transmission were unsuccessful. The results suggest that *A. togoi* is potentially a good vector of other viruses of group A.

Vermeil (C.), Lavillaureix (J.) & Reeb (E.). **Infection et transmission expérimentales du virus West Nile par** *Ornithodoros coniceps* **(Canestrini) de souche tunisienne.**—*Bull. Soc. Path. exot.* **51** (1958) no. 4 pp. 489–495, 15 refs. Paris, 1959.

Ornithodoros coniceps (Can.), which attacks man and infests dwellings in Tunisia, even in urban areas, and also infests birds [*cf. R.A.E.*, B **21** 32; **23** 4–5], was found able to acquire the virus of West Nile encephalitis by feeding in the nymphal stages on infected birds or rodents, to harbour it for at least 44 days (during which moulting occurred) and to transmit it to mice during feeding. In one experiment, the mice showed symptoms of paralysis, but in the other infection was inapparent. Tunisia is visited by migratory birds, and species occur there that are known to harbour West Nile virus in Egypt [*cf.* **46** 158–159].

Mouchet (J.), Gariou (J.) & Rateau (J.). **Distribution géographique et écologique de** *Glossina palpalis palpalis* **Rob.-Desv. et** *Glossina fuscipes fuscipes* **Newst. au Cameroun.**—*Bull. Soc. Path. exot.* **51** (1958) no. 4 pp. 652–661, 1 map, 14 refs. Paris, 1959.

The following is based on the authors' summary. *Glossina palpalis palpalis* (R.-D.) and *G. p. fuscipes* Newst., which the authors regard as distinct species, both occur in the south and centre of the Cameroun Republic. The first has a south-western and the second a north-eastern distribution, but there is a band in the centre in which they overlap. Optimal ecological conditions are practically the same for the two forms, but when these are in competition, *G. p. fuscipes* progressively invades the territory of *G. p. palpalis*, colonising the large watercourses and pushing *G. p. palpalis* back to the small streams, which provide a less favourable habitat. There is no evidence of the existence of hybrids or intermediate forms. Isolated residual foci of *G. p. palpalis* exist in the territory of *G. p. fuscipes*, but the converse is not true, and this supports the hypothesis that *G. p. fuscipes* is an invading form.

Toumanoff (C.). **Filariose humaine et sa transmission dans la Basse-Guinée (estuaire du Rio Nunez).**—*Bull. Soc. Path. exot.* **51** (1958) no. 6 pp. 908–912, 8 refs. Paris, 1959.

A filariasis survey was carried out in the region of the estuary of the Rio Nunez, in Guinea, in the dry season of 1957. This region comprises a coastal zone bordered with mangroves, rich in breeding places of *Anopheles gambiae melas* Theo., and a north-western zone of low flood plains inundated with fresh water for most of the year, where larvae and adults of *A. gambiae* Giles and *Mansonia uniformis* (Theo.) were found. Reports were received of cases of clinical filariasis in the coastal zone, and, of 250 blood smears taken at night from villagers from this area, 12 showed the presence of *Wuchereria* (*Filaria*) *bancrofti* and five that of *Dipetalonema* (*F.*) *perstans*.

Mosquitos taken in dwellings in both zones were dissected and examined for the presence of filariae. Of 34 females of *A. g. melas* and 32 of *M. uniformis* taken in the coastal zone, one and three, respectively, were infected, and of 34 of the latter from the north-western zone, two showed filariae, but the single example of *A. gambiae* dissected did not. In the region of the Rio Nunez, *M. uniformis* bites mainly at night, attacking man both indoors and outdoors. It does not leave dwellings immediately after taking a blood-meal, as both recently gorged females and those containing partly digested blood were found in huts. Study of the stomach contents of *A. g. melas* and *M. uniformis* showed that both mosquitos are essentially anthropophilic. Of the two species, it seems that *M. uniformis* is the more important vector of human filariasis in the dry season.

GRENIER (P.) & MOUCHET (J.). **Premières captures, au Cameroun, d'une simulie du complexe *neavei* sur des crabes de rivières et de *Simulium berneri* Freeman sur des larves d'éphémères. Remarques sur la signification biologique de ces associations.**—*Bull. Soc. Path. exot.* **51** (1958) no. 6 pp. 968–980, 1 fig., 16 refs. Paris, 1959.

Until recently, the three members of the complex of *Simulium neavei* Roub. (*S. neavei*, *S. woodi* De Meillon and *S. nyasalandicum* De Meillon) appeared to be restricted to central and eastern Africa [*cf. R.A.E.*, B **48** 37], but Ovazza found a member of the complex on crabs in the Congo to the north of Brazzaville and one of the authors of the present paper found apparently the same Simuliid on unidentified crabs in a river in the west of the Cameroun Republic. The latter was apparently not *S. neavei*, but rather *S. nyasalandicum* (which it resembled in the coloration of the legs in the adult) or *S. woodi* (on the larval characters) or perhaps an intermediate form. A pupa of *S. berneri* Freeman, the only species known to live in association with Ephemeroptera in western Africa, was found on a larva of *Elassoneuria* in the south. The biological significance of the association of Simuliids with crabs and Ephemeroptera is discussed. The authors do not feel that either phoresy or commensalism alone provides a satisfactory explanation and believe rather that the host provides the developmental stages of Simuliids with shelter from rapidly flowing water and also with a ready supply of nourishment in the form of food fragments carried away by the current.

SYMES (C. B.). **Observations on the epidemiology of filariasis in Fiji.**—*J. trop. Med. Hyg.* **63** nos. 1–3 pp. 1–14, 31–44, 59–67, 14 figs., 23 refs. London, 1960.

The following is based on the author's summary. An account is given of studies made in 1954–56 on the part played by mosquitos in the transmission of the Pacific (non-periodic) form of *Wuchereria bancrofti* [*cf. R.A.E.*, B **42** 84] in Fiji. A mosquito survey showed that 16 species were found, and data are presented on the breeding, distribution and prevalence of some of them and the manner and extent of their contact with man. It is concluded that four species, *Aëdes pseudoscutellaris* (Theo.), *A. polynesiensis* Marks, *A. fijiensis* Marks and *Culex pipiens fatigans* Wied., are concerned in transmission. The first three are about equal in vector-potential, as determined by laboratory infections. *C. p. fatigans* has a lower potential [*cf.* **42** 85; **44** 62], but its wide distribution and abundance probably more than compensate for this. Development of *W. bancrofti* usually takes about two days longer in this species than in the other three. Most microfilariae of *W. bancrofti* taken up by females of *C. annulirostris* Skuse, *A. aegypti* (L.), *A. vexans* (Mg.) and *C. sitiens* Wied. died before or during the first stage of development. The tolerance of *A. horrescens* Edw. to filarial development was not determined.

Evidence is given of a general relation between microfilarial density in the blood of donors and the amount of infection in mosquito vectors fed on them. It is also shown that mosquitos may become lightly infected after feeding on people showing no microfilariae in the blood by the ordinary methods of examination. In view of the difficulty of dissecting the legs of mosquitos, a small study was undertaken to determine what proportion of mosquitos (*A. pseudoscutellaris*) infected in the laboratory had developing filariae in the femora. The proportion was found to be very small, and no mosquitos were infected in the legs only. All stages were present in legs, so that development presumably takes place in them but not to any great extent. Data are given suggesting that when females of *A. pseudoscutellaris* feed on blood containing large numbers of microfilariae, there are more microfilariae in the blood in the stomach immediately after the feed than would be expected. It is also indicated that, during the first 12–24 hours after the feed, about half the microfilariae in the stomach are excreted or lost in some other way. Filarial infection in the human population is discussed. The incidence of infection with microfilariae in the Fijian population sampled was about 30 per cent., and the incidence of clinical filariasis about 5 per cent. Numbers of microfilariae in the peripheral blood fluctuated frequently in 24 hours with a tendency to a peak in the afternoon or evening.

Some preliminary experiments on mosquito control are reported. Attempted reduction of *A. pseudoscutellaris* and *A. polynesiensis* by removal of breeding facilities round villages gave poor results. In simple experiments on the effect of house-spraying to control populations of *A. fijiensis* and *C. p. fatigans* resting in the daytime, a 5 per cent. wettable DDT spray at a rate depositing 1,081 mg. per sq. ft. on sample papers and a 2·5 per cent. wettable dieldrin spray at 359 or 91 mg. per sq. ft. appeared promising. Records are included of the finding of *Dirofilaria immitis* in dogs and six species of mosquitos, but the rates in most species were low compared with the infection rates for *W. bancrofti.*

Burnett (G. F.). **Filariasis research in Fiji 1957–1959.**—*J. trop. Med. Hyg.* **63** nos. 7–9 pp. 153–162, 184–192, 208–215, 30 refs. London, 1960.

The following is based on the author's summary of this account of information on filariasis caused by the Pacific (non-periodic) type of *Wuchereria bancrofti* and its transmission in Fiji, obtained during continuation of the work of C. B. Symes [see preceding abstract], in 1957–59. No additional species of mosquito was found to be a vector. *Aëdes vigilax* (Skuse), which was probably introduced into Fiji in 1957 and is an efficient vector of the non-periodic form of *W. bancrofti* in New Caledonia [*R.A.E.*, B **46** 110], proved to be a poor vector of the Fijian strain. Dissection of many thousands of females of vector species again demonstrated the low rates of infection in mosquitos in Fiji [*cf.* **45** 33]. From a consideration of the proportion of mosquitos taking an infective meal that become infected and survive to contain third-stage larvae, it was calculated that the mean daily mortality of *A. pseudoscutellaris* (Theo.), *A. polynesiensis* Marks and *A. fijiensis* Marks was about 20 per cent. and of *Culex pipiens fatigans* Wied. 29 per cent. Infections were found in mosquitos in gardens far from villages, and were as numerous 300–400 yards from villages as within 200 yards of them, both on and away from tracks. Catches made along tracks and at village boundaries were found to be of equal value for determining mosquito densities. From a study of the relative numbers of mosquito vectors in villages with differing microfilarial rates in the population, it is concluded that *C. p. fatigans* is of minor significance and that *A. polynesiensis* is probably the most important vector, closely followed by *A. pseudoscutellaris*. *A. fijiensis* is important where it occurs, but is restricted in distribution by its specialised breeding sites (axils of *Pandanus*). In four coastal villages, numbers of vectors remained high through unusually dry periods in 1957 and 1958, probably because of crab-hole breeding by *A. polynesiensis* and the ability of *A. fijiensis* to survive in a minimum of fluid in axils.

Attempts to reduce breeding places of *A. polynesiensis* and *A. pseudoscutellaris* by sanitation proved ineffective, as new artificial breeding sites were provided in abundance by the population and it is difficult to destroy all natural sites. Breeding in bamboo pots was prevented by the use of pellets of cement and sand impregnated with 16·3 or 2·5 per cent. dieldrin or 16·3 per cent. technical BHC. One pellet, weighing 5 g., was used per pot containing 400 cc. water. When cost was taken into consideration, BHC gave the best results. The 16·3 per cent. dieldrin pellets also appeared effective in tree holes and crab holes. The crabs (*Cardisoma carnifex* Hbst.) were themselves best controlled with 5 per cent. BHC or 0·5 per cent. aldrin as wettable powders in rice-bran bait. A teaspoonful in each hole gave 90 per cent. control, and reinvasion of a cleared area was very slow, but there was no definite reduction of mosquito populations as a result of the measure. Spraying with 2·5 per cent. dieldrin suspension to give a deposit of 200 mg. per sq. ft. and thatching with leaves both suppressed breeding by *A. pseudoscutellaris* and *A. polynesiensis* in piles of coconut shells for several months. Felling wild *Pandanus* had a marked effect on the numbers of *A. fijiensis* entering one village, but there is evidence that this is not always the case, and extensive natural diversion of breeding to cultivated *Pandanus* was found in one area. Felling round a village may decrease the proportion of mosquitos with mature infections, because of the increased dispersion of females with a long flight to make between breeding and feeding places, and so reduce transmission. Larval control of *C. p. fatigans* by the use of used gear oil in latrines and of larvicides of high spreading ability and dieldrin granules on surface water appeared to be successful in that no breeding was discovered, though many adults were found in the village. It is thought that these came from outside, possibly from the neighbouring village.

Treating the houses in a village with sprays prepared from a dieldrin emulsion concentrate had a marked effect on the numbers of *A. fijiensis* resting in them. This lasted for at least three months after treatment with 26 mg. dieldrin per sq. ft., at least nine months after a second treatment at 132 mg. per sq. ft. and at least six months after a third at 52 mg. The effect on mosquito entry was much more transient and lasted under two, under three and under four months, respectively. It was not possible to show a significant reduction in mosquitos with mature infections, as these had not been numerous before treatment. The effect on *C. p. fatigans* was less lasting; the numbers found resting in houses treated at 40 mg. per sq. ft. began to rise after four months, and had returned to normal in seven. Entry was suppressed for less than three months.

Baisas (F. E.). **Notes on Philippine mosquitoes, XIX. The mosquito problem in the control of filariasis in Sorsogon Province.**—*Philipp. J. Sci.* **86** (1957) no. 1 pp. 71–120, refs. Manila, 1958.

Three annual cycles of house-spraying with DDT in Sorsogon Province in the Philippines [*cf. R.A.E.*, B **44** 45] stopped the transmission of malaria but did not appear to reduce the rate of transmission of filariae [*Wuchereria bancrofti*]. Mosquitos harbouring filariae were repeatedly caught in houses sprayed three times. In one particularly well-treated area, adults of *Culex pipiens fatigans* Wied. were frequently taken resting on walls and other surfaces in sprayed houses, even when traces of DDT were readily visible, and those so caught often survived for two or more days in the laboratory. Moreover, they often harboured filariae that had developed to the infective stage. Of 1,613 mosquitos taken in treated houses in June–August 1956 and dissected, 194 out of 1,394 females of *C. p. fatigans*, one out of two of *Aëdes poicilius* (Theo.) and three out of nine of *C. fuscocephalus* Theo. were infected, and 21 females of *C. p. fatigans* harboured infective third-stage larvae. Since *C. p. fatigans* is closely associated with man in dwellings, both at night and by day, the author considers this mosquito likely to be responsible for more transmissions than is *A. poicilius* [*cf.* **44** 208–209]. The latter, which enters houses late in the evening and leaves early, and often bites outdoors in plantations of abacá [*Musa textilis*], also seems difficult to control with insecticides. *C. fuscocephalus* and *Mansonia uniformis* (Theo.) both had infection rates of about 31·5 per cent. in Sorsogon Province, but infective larvae were not found in them.

Saliternik (Z.). *Anopheles sacharovi* **Favr in Israel.**—*Riv. Parassit.* **18** no. 4 pp. 249–265, 2 pls., 3 graphs, 17 refs. Rome, 1957. (With a summary in Italian.)

Anopheles sacharovi Favr was formerly the principal vector of malaria in Israel. It bred in swamps, ponds or rivers that were almost stagnant, exposed to sunlight and covered with horizontal vegetation [*cf. R.A.E.*, B **30** 185; **31** 68]. There were two peaks of adult density, in April–June and October–December, and breeding was most intense in May–June and October. Details of its life-cycle and temperature relations are given. The females overwintered in a state of semi-hibernation, and dispersed in autumn for up to nine miles in search of suitable winter quarters [*cf.* **47** 116]. Up to 1949, breeding occurred throughout Israel, except for the southern desert, but by 1956, as a result of drainage, anti-larval measures and house-spraying with DDT, which was begun in 1945, it had been restricted to a narrow area of the Huleh swamp and isolated parts of the Jordan valley. In consequence, the first peak in adult numbers no longer occurs and the second has been greatly reduced, so that there is little transmission of malaria in November–December. Most new cases now appear in October, and are the result of transmission by the semi-domestic species, *A. sergentii* (Theo.) [*cf.* **43** 171–172]. The adaptation of antimalarial measures to the specific biology of *A. sacharovi* is discussed, and suggestions are made for effective biological and chemical measures of control.

Saccà (G.). **La resistenza di** *Musca domestica* **L. agli esteri fosforici in Provincia di Latina.** [Resistance of *M. domestica* to phosphoric esters in the Province of Latina.]—*Riv. Parassit.* **18** no. 4 pp. 289–292, 7 refs. Rome, 1957.

For control of *Musca domestica* L. in the Province of Latina, Italy, diazinon at 0·2 g. per sq. m. applied as a suspension of a paste also containing DDT, was substituted in 1953 for DDT, to which the flies had developed resistance [*R.A.E.*, B **45** 64]. However, evidence of resistance to diazinon was seen in 1956, and a study of this resistance in samples of fly populations from different parts of the province was therefore undertaken. Great variation was found from one locality to another. When the susceptibility of a Swiss control strain was taken as normal (an LD50 of 0·0018 g. per sq. m.), resistance was found to have risen from 5-fold to 60-fold in nature, according to place and season. It was greatest in the central areas.

Bervoets (W.), Bruaux (P.), Lebrun (A.) & Ruzette (M. A.). **La lutte contre** *Chrysomyia putoria* **à Léopoldville et apparition de phénomènes de résistance.**—*Mém. Acad. R. Sci. colon., Cl. Sci. nat.*, 8°. (N.S.) **7** fasc. 4, 53 pp., 2 figs., 14 refs. Brussels, 1958. (With a summary in English.)

Studies were made in Leopoldville from 1952 to 1956 to determine the effectiveness of insecticides against *Chrysomyia putoria* (Wied.), which breeds mainly in the liquid and semi-liquid contents of privies in the African quarters of the city. Control measures carried out from 1949 to 1952 are also reviewed. Anti-larval measures are the only economic means of controlling the fly, and γ BHC at first gave good results. *C. putoria* developed resistance to this, however, and other products, including chlordane, aldrin and dieldrin, gave poor results. Diazinon became available at the end of 1952 and was very effective, but resistance to it soon developed, accompanied by cross-resistance to Chlorthion, parathion and malathion. As malathion was effective at high dosages, it was applied as a routine treatment, but after five months, larvae began to show definite resistance, and cross-resistance to Pyrolan was also demonstrated. It is concluded that, as a result of ten years' intensive use of chemicals at Leopoldville, *C. putoria* has become less susceptible to insecticides of all types. Only an improvement in the methods of disposing of human faeces will result in a permanent alleviation of the problem.

Rogers (A. J.) & Rathburn jr. (C. B.). **Improved methods of formulating granular paris green larvicides.**—*Mosq. News* **20** no. 1 pp. 11–14, 1 ref. Albany, N.Y., 1960.

A granular formulation of paris green was developed as a mosquito larvicide in Florida in which an emulsifiable oil replaces the motor-oil emulsion previously used as the adhesive. Emulsifiable oil is easily sprayed on to vermiculite and, as it contains no water, the formulation need not be dried after mixing. The formulation recommended contains 53 lb. vermiculite, 17 lb. paris green and 30 lb. of a mixture of oil and emulsifier; when commercial 90 per cent. paris-green powder is used, this results in a preparation containing about 15 per cent. paris green by weight, and the percentage of toxicant can be lowered as desired by diluting the paris green with a heavy dust such as calcium carbonate. In tests in 1958, granules containing 10 per cent. paris green and applied at the rate of 6 lb. per acre caused 100 per cent. reduction in the number of larvae of *Aëdes taeniorhynchus* (Wied.) in a mangrove marsh, and tests carried out over two years showed that this dosage gave good control of larvae of *A. taeniorhynchus* in areas where conditions permitted good coverage and where the larvae were well dispersed [*cf. R.A.E.*, B **49** 199]. As conditions vary widely in different areas, dosage rates are probably best determined by experience, and a 10 per cent. formulation at a rate of 10 lb. per acre is suggested as a starting point.

Welch (H. E.) & James (H. G.). **The Belleville trap for quantitative samples of mosquito larvae.**—*Mosq. News* **20** no. 1 pp. 23–26, 2 figs., 4 refs. Albany, N.Y., 1960.

The trap described has been used successfully for sampling *Aëdes* larvae in woodland pools in Canada. A sheet-metal cylinder, 18 in. high, and 9$\frac{13}{16}$ in. in diameter, with a sharpened base, is pressed into the bottom of the pool. Mosquito larvae dive to the bottom of the cylinder, and a cone with a diameter slightly less than that of the cylinder is dropped into the latter and rests on a flange at the bottom of it. The trap is left in this position for 10–20 minutes, during which the enclosed larvae enter the upper part of the cylinder through a 1-in. opening in the apex of the cone. This opening is then closed with a cork. A funnel-shaped concentrator, attached to a bucket with a draining plug in the base, is fitted into the top of the cylinder, and the trap is lifted out of the pool and inverted. The water is allowed to drain into the bucket, which is then removed, and the trap contents are drained into a 2-oz. jar. The larvae thus obtained can be counted in the field or taken away for examination. In tests with known numbers of larvae, the recoveries did not exceed 40 per cent., but were comparable with those obtained by Bidlingmayer [*R.A.E.*, B **44** 58]. Observations showed that some larvae adhere to the cylinder and cone and are not washed down into the concentrator or bucket. This could be remedied by rinsing.

McLintock (J.). **Simplified method for maintaining** *Culex pipiens* **Linnaeus in the laboratory (Diptera: Culicidae).**—*Mosq. News* **20** no. 1 pp. 27–29, 2 refs. Albany, N.Y., 1960.

A method is described whereby a colony of *Culex pipiens* L. has been maintained for 20 months in a laboratory in Canada, with a minimum of labour. All stages of the mosquito are kept in one cage measuring 2 × 2 × 2 ft., at 70–72°F. and 75–80 per cent. relative humidity. The lighting is automatically controlled to operate on a 24-hour cycle giving 17 hours of light, six hours of darkness and two half-hour crepuscular periods, during which swarming and pairing occur. The larval medium consists of Bates' "Medium S" [*R.A.E.*, B **29** 97], a proprietary brain-heart infusion, powdered bakers' yeast and powdered wholemeal bread-crumbs, and further yeast and bread-crumbs added three times a week; compressed air is passed slowly through the medium to prevent scum formation, and the dishes are replaced once or twice a year. Bottles of sugar solution are kept in the cage, and a fowl is provided twice a week as a source of blood for the females. As the latter take blood more readily in the dark, the cage is covered while the fowl is in it. The adults produced are smaller and less uniform in size than those from larvae reared in trays, but the colony appears to be vigorous.

Maldonado-Capriles (J.) & Nasir (A. S.). **DDT-resistant adults of** *Anopheles subpictus* **in the Lahore district of West Pakistan.**—*Mosq. News* **20** no. 1 pp. 52–54, 5 refs. Albany, N.Y., 1960.

In tests in West Pakistan in August 1958, adults of *Anopheles subpictus* Grassi from two DDT-sprayed villages near Lahore showed resistance to this insecticide when exposed to WHO filter papers bearing deposits of it [*R.A.E.*, B **49** 199].

Bami (H. L.), Sharma (M. I. D.) & Kalra (R. L.). **A note on the metabolism of DDT in normal and DDT resistant** *Culex fatigans*.—*Bull. nat. Soc. India Malar.* **5** no. 5 pp. 246–247, 11 refs. Delhi, 1957.

Females of a DDT-resistant strain of *Culex pipiens fatigans* Wied. from a village near Delhi detoxified topically applied p,p′DDT to DDE to a greater extent than did females of a normal strain.

Ray (A. P.). **Analysis of data on Culicine density and filaria infection rate in three areas in Bihar.**—*Bull. nat. Soc. India Malar.* **5** no. 6 pp. 259–263, 2 graphs, 2 refs. Delhi, 1957.

Data on filariasis obtained in 1955–57 in three areas in Bihar where infection is with *Wuchereria bancrofti* and the vector is *Culex pipiens fatigans* Wied. were analysed. The density of the mosquito was significantly higher during the dry than during the wet season, possibly because lack of water and the comparatively greater rate of evaporation in the dry season result in the higher concentration of organic matter in the breeding places that is required for breeding. As *C. p. fatigans* was found to be infected with filariae through almost all the year, it seems that transmission occurs continuously. The infection rate in the vector was considerably higher in the wet than in the dry season [*cf. R.A.E.*, B **18** 140], and was therefore inversely related to vector density. The peak in the infection rate seemed to occur between July and September, coinciding with the malaria transmission season in these areas.

Bhatia (M. L.) & Wattal (B. L.). **Tolerated density of** *Culex fatigans* **Wied. in transmission of bancroftian filaria.**—*Bull. nat. Soc. India Malar.* **6** no. 4 pp. 117–122, 9 refs. Delhi, 1958.

From data on the density of *Culex pipiens fatigans* Wied. in areas in India in which filariasis caused by *Wuchereria bancrofti* does and does not occur, it is concluded that transmission does not take place where the density of the mosquito does not exceed 34 per ten man-hours during the seasons in which the climate favours the development of the parasite. This is designated as the tolerated density, *i.e.*, the highest density at which there is no risk of transmission.

Ehrlich (S.) & Spielberg (D.). **Alteration of the environment of** *Anopheles* **larvae by nutria in the Naaman swamps, Acre District, Israel.**—*Amer. J. trop. Med. Hyg.* **9** no. 3 pp. 265–268, 5 figs. Baltimore, Md., 1960.

Nutria [coypu (*Myocastor coypus*)] have become established in a feral state in the malarious swamps of the upper Naaman river, near Acre, in Israel, and their activities were compared with direct methods of removing aquatic vegetation for their effectiveness in controlling Anopheline larvae. It was found that the mechanical or chemical destruction of emergent vegetation usually resulted in abundant growth of filamentous algae, forming mats on the surface of the water, and of other vegetation, that furnished excellent cover and food for larvae of *Anopheles sacharovi* Favr and other species and also interfered with drainage. A nutria population of suitable density cleared the course of the river and adjacent ponds of vegetation (mainly *Typha* and *Scirpus*) and kept them clear, without the formation of mats of algae, for three years without harming the bank vegetation. These observations were confirmed in five fenced pond farms in various parts of the country, except that conditions favourable to filamentous algae were once temporarily created during destruction of a strong growth of reeds (*Phragmites*). In the sector of the Naaman kept permanently clear of weeds by nutria, the drainage capacity of the river and ditches was maintained and spraying with insecticide could be more accurately carried out.

Tekle (A.). **The physiology of hibernation and its role in the geographical distribution of populations of the** *Culex pipiens* **complex.**—*Amer. J. trop. Med. Hyg.* **9** no. 3 pp. 321–330, 14 refs. Baltimore, Md., 1960.

The following is based mainly on the author's summary. The investigation described was designed to determine the effect, if any, of temperature as a limiting factor in the distribution of *Culex pipiens pipiens* L. and *C. p. fatigans* Wied. in the United States [*cf. R.A.E.*, B **47** 93] and to reveal any differences that might exist in the adaptation of the two subspecies to hibernation. In both, the lower the temperature of the water in which the larvae were reared, the longer was the developmental time, and the greater were the body-weight, fat-content and wing-length of the females. However, the ratio of fat-content to dry body-weight remained constant, whatever the breeding temperature. Sugar-fed females stored a large amount of fat but not so much as was found in females caught in nature during winter. Oxygen was consumed at a lower rate at low than at high temperatures and by young and unfed females than by sugar-fed ones. Young and unfed mosquitos of both subspecies consumed oxygen at the same rate; but, after sugar feeding, the rate was significantly higher in *C. p. pipiens* than in *C. p. fatigans*. This is interpreted as a metabolic compensation to temperature in *C. p. pipiens*, which normally lives in colder regions. The rearing temperature did not affect the rate of oxygen consumption of the adults. The stored fat of sugar-fed *pipiens* and *fatigans* females decreased during simulated hibernation; however, the rate of fat decrease was greater in the former than in the latter. When *fatigans* females were dying, their fat-content was almost twice that of *pipiens* females, and the surviving *pipiens* females outnumbered *fatigans* females by 3:1 at that time. As temperature decreased, the time needed for blood digestion and for oviposition increased, and fewer females oviposited. At 5°C. [41°F.], *pipiens* females digested their blood-meals in about 60 days but did not oviposit, whereas females of *fatigans* did not survive long enough to digest their blood-meals.

It is concluded that the temperature at which the larvae are reared has no effect on the ability of the emerging mosquitos to enter hibernation directly, that females of *fatigans*, like those of the northern *pipiens*, can accumulate fat reserves if given a carbohydrate diet before hibernation, and that hibernating *pipiens* females outlive *fatigans* females because they can use their fat reserves, whereas *fatigans* females cannot. The inability of females of *C. p. fatigans* to survive long hibernation periods at low temperatures may be an important reason for the absence of this subspecies from colder regions [*cf.* **40** 68].

Parker (A. C. M.) & Rozeboom (L. E.). **The effect of temperature and illumination on mating of** *Culex pipiens pipiens* **L. and** *C. p. fatigans* **Wied.**—*Amer. J. trop. Med. Hyg.* **9** no. 3 pp. 331–335, 9 refs. Baltimore, Md., 1960.

Mating experiments with strains of *Culex pipiens pipiens* L. from Baltimore and its neighbourhood and of *C. p. fatigans* Wied. from Texas and the Philippines at temperatures between 15 and 35°C. [59 and 95°F.] showed that *C. p. fatigans* paired more actively at all temperatures and was less inhibited than *C. p. pipiens* at the highest [*cf. R.A.E.*, B **40** 68]. Adults of a Baltimore strain of *C. p. molestus* Forsk., which occurs only in the range of *C. p. pipiens*, were more active than those of *C. p. fatigans* at high as well as at low temperatures. With decreasing light intensity, adults of *C. p. fatigans* began swarming sooner than did those of *C. p. pipiens* (at 0·15 foot-candle in the Philippine strain of *fatigans*), but ceased shortly after darkness became complete, whereas *C. p. pipiens* began to swarm at 0·05 foot-candle and continued to do so in the dark. Some insemination of *fatigans* females took place during swarming.

It is concluded that *C. p. fatigans* has no specific adaptation for mating at high temperatures and that the higher insemination rates at all temperatures were the result of inherent sexual aggressiveness. This difference in activity might limit the establishment of *C. p. pipiens* in warmer areas in which it would have to compete with the more active *C. p. fatigans*. Differences in response to temperature and light might be responsible for segregation of the populations in areas where both exist.

BERTRAM (D. S.) & SAMARAWICKREMA (W. A.). **Age determination for individual** *Mansonioides* **mosquitoes.**—*Nature* **182** no. 4633 pp. 444–446, 2 figs., 11 refs. London, 1958.

To examine the possibility of determining the age of individual females of *Mansonia* (*Mansonioides*) by a count of the corpora lutea [*cf. R.A.E.*, B **48** 215], adults of *M. uniformis* (Theo.) and *M. annulifera* (Theo.) were reared by the method of Laurence & Smith [**49** 17] and given blood-meals on the human arm. They first fed readily three days after emergence and became gravid four days after feeding. Subsequent blood-meals were given within 12–18 hours of oviposition and each gonotrophic cycle was completed in four days. The procedure was continued through six cycles with *M. uniformis* and three with *M. annulifera*, and the ovariole structure of females dissected at intervals was observed. The maximum number of corpora lutea in an ovariole corresponded with the number of gonotrophic cycles known to have been completed. Other methods of determining the age of mosquitos are briefly reviewed.

COLLESS (D. H.). **Relationship between certain biological constants and trophic condition in mosquito populations.**—*Nature* **182** no. 4640 pp. 951–952, 2 refs. London, 1958.

A method similar to that developed by Davidson to calculate the proportion of a mosquito population that is parous [*R.A.E.*, B **44** 178] is used to derive a general expression for determining the proportion of a population that is unfed. If the unfed proportion of a population in steady equilibrium, or the proportion that is fed or developing eggs, is known from representative samples from natural resting places, a knowledge of any three of the quantities p (daily survival rate), n (days from emergence to first feed), d (days taken to develop eggs up to the first deposition) and c (d + days from oviposition to next feed) allows calculation of the fourth. In practice, this will usually mean calculation of survival rate from details of the gonotrophic cycle. It appears that, in certain species at least, the relation described may provide a means of following changes in survival rate, for example, during control campaigns. Where anomalous gonotrophic cycles occur, the equations will need modification.

Davies (M.), Keiding (J.) & von Hofsten (C. G.). **Resistance to pyrethrins and to pyrethrins-piperonyl butoxide in a wild strain of** ***Musca domestica*** **L. in Sweden.**—*Nature* **182** no. 4652 pp. 1816–1817, 2 refs. London, 1958.

Preparations containing pyrethrins and piperonyl butoxide, applied on a farm near Stockholm late in 1956 and early in 1957 against a population of *Musca domestica* L. resistant to chlorinated hydrocarbons and to parathion, no longer gave control of the flies by October 1957. When a 1:10 mixture of pyrethrins and piperonyl butoxide was applied topically in acetone to females of the first generation of a colony of *M. domestica* established from larvae and pupae collected on the farm, the LD50's showed that they were 11–14 times as tolerant of the mixture as females of susceptible strains; after seven generations in the laboratory without exposure to insecticides, resistance had decreased significantly but was still very high. The field strain was highly resistant to chlorinated hydrocarbons and 30 and six times as resistant to diazinon and parathion, respectively, as normal strains. Laboratory strains that were resistant to chlorinated hydrocarbons or organophosphorus compounds were found to be 2–4 times more tolerant of synergised pyrethrins than was a normal strain [*cf. R.A.E.*, B **48** 137], indicating that resistance to synergised pyrethrins is due partly to non-specific factors (vigour tolerance [**49** 231]) and partly to specific defence mechanisms against the toxicant. In further experiments, flies from the F_3 generation of the field strain, bred under standard conditions, were sprayed with pyrethrins alone or in a 1:8 mixture with piperonyl butoxide in kerosene and found to be 12·5 and 10·7 times as resistant, respectively, as the normal strain. Resistance of this strain to allethrin was also indicated; when a measured-drop technique was used, resistance to allethrin, alone or with piperonyl butoxide, was about 150 and 45 times, respectively, that of the normal laboratory strain.

Stoll (N. R.) & others. Ed. **International Code of Zoological Nomenclature adopted by the XV International Congress of Zoology.** [*In French & English.*]—$8\frac{3}{4} \times 5\frac{1}{2}$ in., xviii + 176 pp. London, Int. Comm. zool. Nom., 1961. Price £1.

The first internationally accepted rules of zoological nomenclature, the *Règles Internationales de la Nomenclature Zoologique*, were issued in 1905, in French, with English and German translations. Amendments and additions were made by subsequent International Congresses of Zoology, and those made at the XIV Congress in 1953 were separately published as *Copenhagen Decisions on Zoological Nomenclature*. The present revision, which was adopted by the XV International Congress in London in 1958, is the only complete text officially to supersede the original *Règles*. The rules are drafted in English and French, preceded by a preface and an introduction in English and followed by five appendices, a glossary of terms and an index, all in English and French. The appendices, which are provided as a guide to good usage but do not have the force of rules, comprise a code of ethics to be observed in the publication of new names, a table showing the procedure to be followed in the latinisation of Greek words, directions as to the spellings to be adopted in the latinisation of the geographical and proper names of countries not using the Latin alphabet, recommendations on the formation of names and general recommendations.

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